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Issued December 15, 1911.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS AND BUREAU OF PLANT INDUSTRY COOPERATING.

Report No. 96.

SOILS OF THE PRAIRIE REGIONS OF ALABAMA AND MISSISSIPPI AND THEIR USE FOR ALFALFA.

PART I.

HOUSTON CLAY AND ASSOCIATED SOILS.

BY

HUGH H. BENNETT,

Scientist in Soil Survey, Bureau of Soils.

PART II.

ALFALFA ON THE HOUSTON CLAY: ITS CULTURE AND MANAGEMENT.

BY

M. A. CROSBY,

Assistant Agriculturist, Bureau of Plant Industry.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Washington, D. C., May 18, 1911.

Sir: We have the honor to transmit herewith the manuscript of an article entitled "Soils of the Prairie Regions of Alabama and Mississippi and Their Use for Alfalfa."

Part I, dealing with the character and location of the soils, was prepared by Mr. Hugh H. Bennett, inspector of the southern division of the soil survey of the Bureau of Soils, and Part II, bearing upon the methods of alfalfa production, was prepared by Mr. M. A. Crosby, assistant agriculturist of the Bureau of Plant Industry.

The material should be valuable as a guide to those interested in cultivating these rich prairie lands. Many inquiries are being received by the Department relative to the location and character of these soils, and particularly in regard to the possibilities of alfalfa production here. The Houston clay, of which there is in the neighborhood of 1,000,000 acres within these States, is probably the most productive of the extensively developed upland soils of the Gulf Coastal Plain east of the Mississippi River. Its admirable adaptation to the production of cotton and of alfalfa, corn, grass, and a number of other forage crops makes it an important agricultural asset of the States mentioned.

It is believed that the material submitted will be of great help in bringing about the proper appreciation and a better utilization of the Houston clay and its associated soils, and that much assistance will be afforded the increasing number of farmers interested in the production of alfalfa. To others outside the sections where these lands are found the information given is likely also to prove of interest.

We have the honor to recommend that the articles be published as a joint report of the two bureaus cooperating and issued from the Office of the Secretary as Report No. 96.

Respectfully,

Milton Whitney,
Chief of Bureau of Soils.
B. T. Galloway,
Chief of Bureau of Plant Industry.

Hon. James Wilson,
Secretary of Agriculture.

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SOILS OF THE PRAIRIE REGIONS OF ALABAMA AND MISSISSIPPI AND THEIR USE FOR ALFALFA.

PART I. HOUSTON CLAY AND ASSOCIATED SOILS.

By Hugh H. Bennett, *Scientist in Soil Survey, Bureau of Soils.*

INTRODUCTION.

Throughout the prairie belts of central Alabama and northwestern and central Mississippi occur extensive areas of a dark-colored upland calcareous clay soil which, in addition to being admirably suited to the production of cotton, corn, and grass, is highly adapted to alfalfa.

This upland type of "black prairie land" has been classified by the Bureau of Soils as Houston clay. It is distinctly different from any other soil in the southeastern part of the United States, except an alluvial type derived from it, the Trinity clay, which is also a dark-colored soil rich in lime. These soils are also extensively developed in the prairie or "black waxy land" regions of Texas, where they were first mapped and named. Owing to the fact, however, that the extent of the Houston and Trinity soils in Texas has not yet been so completely determined as in Alabama and Mississippi, and for the further reason that different climatic conditions prevail over these lands as developed in the State of Texas, this bulletin, for the sake of direct and brief treatment, will take up only the Alabama-Mississippi region, throughout which both soil and climate are strikingly uniform. While the Houston clay is the dominant upland prairie type, there are occasional small areas of a closely related soil, the Houston chalk, and some patches also of another related type, the Houston loam.

OCCURRENCE OF HOUSTON AND TRINITY SOILS IN ALABAMA AND MISSISSIPPI.

The Houston and Trinity soils have been carefully studied and their location and extent accurately shown on soil maps covering a number of representative areas in Alabama and Mississippi. These soils are most typically and extensively developed in these States in the section sometimes called the "central or upper prairie belt" in

Alabama and the "northeastern prairie belt" in Mississippi, as distinguished from the lower prairie belt to the south. (See Fig. 1). The prairie regions are popularly known as the "black belt" or "black prairie belt."

Neither belt is occupied exclusively by the Houston or Trinity clay, nor do these soils occur everywhere as the predominant types. Their total acreage, however, together with their high agricultural value, is sufficient to make them conspicuously important.

UPPER PRAIRIE BELT.

The upper prairie belt, with an approximate average width of 30 miles, extends from about the center of Bullock County in central-eastern Alabama in a westerly direction to Dallas County, thence northwest through Sumter County, across the Mississippi line to Clay County, and finally due north to the vicinity of the Tennessee line. It includes in Alabama portions of Bullock, Macon, Montgomery, Lowndes, Autauga, Butler, Wilcox, Dallas, Perry, Marengo, Hale, Greene, Pickens, and Sumter Counties, and in Mississippi, portions of Kemper, Noxubee, Lowndes, Oktibbeha, Clay, Monroe, Chickasaw, Pontotoc, Lee, Union, Prentiss, and Alcorn Counties. The boundaries of this belt are quite irregularly defined and the included Houston and Trinity soils occur in detached or semidetached areas intimately associated with other soils widely different in geological origin, character of component materials, and agricultural value.

The whole of the region in which the Houston clay occurs is underlain at varying depths by a stratum of highly calcareous material, consisting largely of a pale bluish soft limestone, geologically known as the Selma chalk formation of Cretaceous age.

Throughout this soft limestone embedded fossil remains of marine life, principally shellfish, are of common occurrence, and not infrequently the bones of huge prehistoric animals are encountered in excavating. The constituent material of this limestone was deposited in an ancient sea which at one time covered nearly all of the State of Mississippi and more than half of Alabama.[1] The homogeneity and fine texture of the particles of the Selma chalk evinces formation, through off-shore, deep-water or quiet-water deposition. Of the material washed into the sea from land areas the finer particles, silt and clay, were held in suspension longer than the coarser particles and carried farther from shore where they were laid down below the disturbing influence of tides and waves, being markedly influenced only by the intermingling of the calcareous remains of marine life. The

[1] In past ages probably all of the State of Mississippi and nearly all of Alabama was covered by water into which varied material was washed and deposited. Since the emergence of the land, erosion has removed much of this sedimentary material thus moving the line of the northern boundary of the original Coastal Plain deposits farther south.

Selma chalk varies in thickness from several hundred to something over 1,000 feet.[1] Throughout its entire extent the material from which the Houston clay is directly and the Trinity clay indirectly derived is remarkably uniform in character. There are, however, minor local differences, consisting mostly of variation in content of argillaceous and calcareous material and in degree of hardness. Prevailingly, the material consists of argillaceous to chalky, very fine grained, soft limestone. Although quite compact even the freshly exposed rock is easily cut with a knife and often can be broken with the fingers. The lime content averages very high, not infrequently running above 90 per cent and occasionally as high as 98 per cent of calcium carbonate.[2] There are, however, places where the typical limestone merges into calcareous clay,[3] while on the other hand some localities show a much harder pure limestone [4] which has been used, though with only a moderate degree of success, as road surfacing material.

The typical faint bluish, compact, limestone when acted upon by the agencies of weathering, loses much of the lime, assumes a grayish to white color, and becomes noticeably softer. This lighter colored, softer, or weathered portion of the Selma chalk is popularly styled "rotten limestone."[5] The removal of lime by solution increases the relative proportion of clayey material in the residual product, the lime content decreasing as the surface portion or zone of maximum lixiviation is approached. Accumulated organic matter, the remains of vegetation, darkened, probably through the action of lime, has imparted to the surface soil a grayish-brown to black color.

Before the attainment of the present condition the Selma chalk formation was lifted above the sea, subjected to erosion, and resubmerged. Over this unevenly eroded surface other deposits of entirely different material were subsequently laid down. With alternate emergence and submergence, successive depositions and erosion made possible the unconformable superimposition of a number of different formations, so that much of the Selma chalk though constituting the basal stratum of the entire upper prairie belt is overlain by variable material of decidedly different character. In this way the Houston clay is closely associated with soils derived from other younger formations, as, for example, the Orangeburg soils from the superimposed Lafayette formation, remnants of which have withstood erosion.

[1] Mississippi State geological survey, Bulletin No. 1, p. 42.

[2] Loc. cit., pp. 47–53.

[3] Loc. cit., p. 54.

[4] Loc. cit., p. 41.

[5] The entire Selma chalk formation has been frequently referred to by geologists as "the Rotten Limestone."

LOWER PRAIRIE BELT.

The Houston clay occurs in widely separated and comparatively small, though conspicuous, areas in the lower prairie belt, which crosses Mississippi from near the loess formation in Rankin County in a southeasterly direction and extends into Alabama as far as Clarke County. This belt includes portions of Choctaw, Clarke, Monroe, and Washington Counties in Alabama and portions of Clarke, Jasper, Newton, Rankin, Scott, Smith, and Wayne Counties in Mississippi, with possible patches near the western extension of the Vicksburg and Jackson formations in Madison County.

The Houston clay is very much less extensively developed here than in the upper belt; in fact the formation giving rise to this type of soil in a number of counties outcrops sufficiently to form only isolated patches.

The Houston clay of the lower belt is derived from the hard to soft light-colored fossiliferous limestone of the Vicksburg formation, and probably also from calcareous clays of the next older and closely associated Jackson formation, both of which are of Tertiary age. Where exposed these formations weather into a clay essentially identical with the Houston clay of the Upper or Cretaceous belt.

THE HOUSTON CLAY.

CHARACTER OF THE SOIL.

The soil of the Houston clay, in its typical development, consists of a dark-gray to black silty clay loam to clay,[1] ranging from something like 5 to about 15 inches in depth. The subsoil is a light-gray to yellowish-brown stiff tenacious silty clay, which frequently grades into the nearly white, highly calcareous,[2] chalky limestone at a depth of from 2 to 3 feet.

[1] The average results of mechanical analyses of representative samples of soil and subsoil of the Houston clay from Alabama and Mississippi are given in the following table:

Mechanical analyses of Houston clay.

Section.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Soil	0.9	2.5	2.3	10.3	11.2	44.4	28.0
Subsoil	.6	1.5	1.5	8.3	8.7	40.6	38.8

[2] The lime content (calcium carbonate) of a number of representative samples of the Houston clay from Alabama and Mississippi Counties is shown in the table below:

Content of lime ($CaCO_3$) of Houston clay.

Area.	Soil.	Subsoil.	Reference.
	Per cent.	*Per cent.*	
Dallas County, Ala	24.20	51.91	Field Operations, 1905.
Montgomery County, Ala	28.79	45.17	Do.
Sumter County, Ala	24.00	76.00	Field Operations, 1904.
Do	4.8	53.10	Do.
Pontotoc County, Miss	27.9	28.70	Field Operations, 1906.

There is not always a distinct line of demarcation between soil and subsoil, the change frequently being gradual. Also the subsoil material becomes firmer and the lime content increases downward, there being a gradual transition through soft, nearly white, partly weathered limestone finally into the characteristic compact, pale-blue, unaltered parent rock. Some noticeable variations in the color and character of both soil and subsoil are of local importance. Not infrequently the soil of imperfectly drained level and slightly depressed areas is nearly black or brownish, with sometimes faint reddish mottling, to a depth of 3 feet or more. In other localities much of the type will show a brownish subsoil, often mottled with shades of red, resting directly upon the little altered parent limestone. The reddish mottling in many instances is due to discoloration through the weathering of pyrite concretions, which are of quite common occurrence in the limestone formation. Not uncommonly exposed sections of the Selma chalk are streaked with reddish-brown colors, caused by the action of sulphuric acid, set free in the weathering of the pyrites, upon the iron components of the concretions themselves or of the limestone or of both. Reddish mottling is also due in places to an admixture of material derived from remnants of an overlying formation, the greater part of which has been removed by erosion. Some fields, especially when freshly ploughed, have a spotted appearance by reason of the patchy occurrences of reddish or brownish soils, usually Oktibbeha and Susquehanna types. A faint greenish cast is noticeable occasionally in both the soil and subsoil, and other color variations of minor importance are seen, but on the whole uneroded areas are quite uniformly dark gray to nearly black in color.

The grayish phase is confined largely to slopes and knolls of the more elevated areas where erosion has removed the darker surface soil or where the more rapid drainage has assisted in the removal of the organic matter or the retardation of its accumulation. This surface waste has exposed the grayish subsoil and even the freshly weathered, white limestone in places along slopes, giving rise to a spotted soil sometimes locally styled "tallow ridge land." Where the Houston clay is mixed with other soils, for instance, with the "red post-oak land," erosion has in local areas brought about an extremely spotted surface appearance of grayish, reddish, brownish, and darker colors. Such areas are locally known as "calico prairie," or "mixed prairie."

The most severely eroded areas, including those in which the surface soil has been bodily removed, exposing the white chalky material or parent limestone, are styled "lime hills." These where of considerable extent have been mapped separately in the soil survey under the name of Houston chalk.

Along many of the small drainage ways of the larger uniform areas of the black prairie land there is very little true alluvial soil, but often the surface soil is darker, slightly more loamy, and considerably deeper than in the upland levels, owing to accumulation of washed-in mineral and organic matter.

Small calcareous concretions and buckshotlike iron gravel (concretionary) are of common occurrence in the surface soil. Water-worn quartz pebbles are occasionally seen scattered over local areas. Fossil shells frequently occur in both soil and subsoil.

EXTENT OF TYPE.

On July 1, 1910, there had been mapped by the Bureau of Soils 392,976 acres of Houston clay in Alabama and 189,568 acres in Mississippi. This total area is distributed in these States as shown in the following table:

TABLE 1.—*Extent and distribution of Houston clay as shown by surveys completed to July 10, 1910.*

ALABAMA.

County.	Acres.	Square miles.	County.	Acres.	Square miles.
Autauga	1,664	2.6	Montgomery	88,400	138.1
Butler	10,880	17.0	Perry [1]	68,064	106.3
Dallas [1]	74,592	116.6	Sumter [3]	85,696	133.9
Hale	55,104	86.1			
Macon [2]	8,576	13.4	Total	392,976	614

MISSISSIPPI.

Clay	28,608	44.7	Pontotoc	11,008	17.2
Jasper [4]	11,392	17.8	Prentiss	5,632	8.8
Monroe	58,176	90.9			
Noxubee	64,384	100.6	Total	189,568	296.2
Oktibbeha	10,368	16.2			

[1] In Dallas and Perry Counties, Ala., 149,184 and 136,128 acres, respectively, have been mapped as Houston clay, but probably one-half of this is "post-oak" land. No differentiation was made in these early surveys between Houston clay and such "post-oak" land as is now being mapped in the Oktibbeha series.
[2] Mapped as Houston black clay.
[3] Mapped in part as Houston black clay.
[4] Jasper County lies in the lower prairie belt.

The illustration (fig. 1) on page 11 shows the general outline of the black prairie belts in Alabama and Mississippi, marking the boundaries of both the surveyed and unsurveyed territory in which the Houston clay occurs as an important soil type. There are a number of small isolated areas, as those mapped in Autauga County, Ala., which lie without the general belt, and which are not included in the sketch map of the prairie belt proper. There are probably several hundred thousand acres of Houston clay in the unmapped portion of the region, putting the total occurrence (surveyed and estimated) of this valuable soil in Alabama and Mississippi at something like a million acres.

LOCAL NAMES.

The Houston clay is variously styled "prairie," "prairie land," "black prairie," and "black land." Local variations differing from the typical phase in having a lighter colored and more calcareous surface soil are known as "gray prairie," "ash prairie," "white prairie," and "bald prairie." Occasional patches thickly strewn with shells are termed "shell land." Such names as "post-oak prairie" and "red prairie" are used in the black belt generally to designate soils of the Oktibbeha and Susquehanna series, which are very unlike the Houston clay both in character of material and in agricultural value. These soils as well as a number of other associated types are

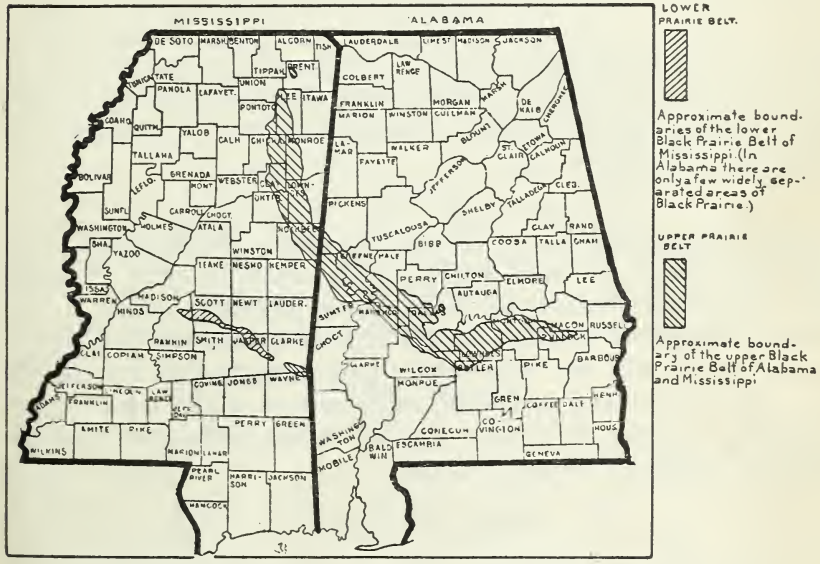
MISSISSIPPI
ALABAMA
LOWER PRAIRIE BELT.
Approximate boundaries of the lower Black Prairie Belt of Mississippi. (In Alabama there are only a few widely separated areas of Black Prairie.)
UPPER PRAIRIE BELT
Approximate boundary of the upper Black Prairie Belt of Alabama and Mississippi

FIG. 1.—Sketch map showing lower and upper prairie belts of Mississippi and Alabama.

described in subsequent pages, in order that they may not be confused with the Houston or Trinity soils, to which this bulletin is primarily devoted.

TOPOGRAPHY.

In typically developed areas the surface configuration varies from flat or undulating to gently rolling. Plate I, figure 1, shows a typical flat area. Large areas, uninterrupted except by an occasional ridge or slight knoll, marking usually the location of some other soil type, afford a view very similar to that of the prairies of the Central Western and Northern States.

There are few abrupt breaks in the topography such as are encountered in more rolling sections, where streams have cut deep

valleys. From the crests of the rather slight elevations usually there is a gentle decline to the broad flat-bottomed shallow valleys of the larger streams, occupied chiefly by Trinity clay.

EROSION.

The prevailing gentle slopes offer effective resistance to erosion, especially where those methods of cultivation are employed which do not encourage soil waste through accelerated surface drainage. In the vicinity of an occasional stream having steep valley walls, some of which in places are marked by blufflike escarpments, erosion has been quite active.

Notwithstanding the prevailing smooth, uneroded surface, patchy occurrences of washed and gullied areas, the result mainly of careless soil management, are of far too frequent occurrence. Under a careful system of soil management such as is employed by some of the more progressive farmers there is little danger of serious erosion; in fact, most of those patches already badly washed can be reclaimed to profitable agriculture.

DRAINAGE.

On the whole the type is very well drained. Occasional flat and depressed areas need open ditches or tile drains to carry off water that sometimes accumulates in excessive quantities owing to the absence of efficient drainage outlets or sufficient surface declivity to permit proper run off. The small prairie streams run dry quickly even after heavy and protracted rains because of the rapid surface drainage, the good absorptive capacity of the surface soil, and the rarity or entire absence of springs.[1]

WORKING QUALITIES.

Topographically the Houston clay is admirably suited to cultural operations, including the use of gang and steam plows. Heavy draft, however, is required for plowing unless the moisture content is exactly right and good structural conditions have been maintained in past seasons through timely cultivation and replenishment of organic matter. Clods formed in cultivating under favorable conditions of moisture on drying readily break down into a desirable

[1] In some fields crawfish do considerable damage to young plants, especially alfalfa, cotton, and corn. The crawfish, in order to reach water, digs a hole to considerable depths, sometimes probably 10 or 15 feet. In the construction of these holes light-colored clay is brought to the surface and stacked around the entrance in cylindrical chimneys in a way to give fields a curiously spotted appearance. Sometimes just following spring rains many young plants are destroyed over night in badly infested fields. The best method of circumventing the ravages of crawfish in the case of alfalfa is to seed in the fall, when the crustaceans are less active. This anomalous occurrence of crawfish in well-drained upland soil, although living in deep holes holding water, aside from being interesting, presents a rather puzzling problem to the agriculturist. As yet no effective way to destroy the pests has been devised, further than the laborious method of picking them up by lantern light. Fortunately only a comparatively small area is infested, and it seems that there is not much likelihood that this area will be extended.

granular tilth. This tendency to assume a granular structure is due both to flocculation of the clay particles, induced by the lime present, and to the granulating or loosening effect of organic matter. In consequence of such structural characteristics an excellent tilth is easily maintained, which, together with the fine texture of the soil, favors easy cultivation and the maintenance, under anything like normal seasonal conditions, of a supply of moisture adequate for all crops suited to the type. Some crops do suffer, however, during long-continued droughts, especially where the organic matter content has been greatly diminished through the continued growing of clean-cultivated crops without addition of vegetable manures. On those areas, also, where there is only a shallow soil covering crops are particularly liable to suffer in dry seasons.

When wet the surface soil becomes so extremely sticky that working is very difficult. Roads not surfaced with sand or some water-shedding material are quickly worked up, becoming sometimes well-nigh impassable. In dry weather, however, the kneaded clay soon compacts with traffic to form a hard surface which has a smooth, polished appearance. The soil is quite susceptible to cracking in dry weather (see Pl. I, fig. 2), sometimes to the extent of affording unsafe footing to horses. This cracking in a way is a desirable feature in that it amounts to the formation of a natural mulch. On the other hand, the cracks sometime assist in erosion, particularly on slopes.[1]

TIMBER GROWTH.

Within historic time the Houston clay has supported no timber growth worthy the name, for which reason it has been correctly designated "prairie land." Clumps of crab apple, plum thickets, and an occasional locust and cedar are seen here and there, especially in unused and eroded fields. Some of the soil as developed in the lower prairie belt is said to have supported an original growth of black-jack oak, shortleaf pine, and wild plum, but it is not certain that such areas are entirely representative of the type.

Osage orange, or "bois d'arc," as it is frequently called, when once established makes a wonderful growth on this soil, and hedges of this tree have been utilized as fences to a considerable extent. When trimmed regularly these hedges are quite attractive, giving a pleasing appearance to inclosed fields and yards. (Pl. II, fig. 1.) The tendency of the trees to encroach upon fields through the springing up of young plants from the widespreading lateral roots has made this method of inclosing fields unpopular with many farmers. Con-

[1] For a further discussion of the Houston clay—description of topography, drainage, etc.—see soil survey reports of the following counties: Autauga, Butler, Dallas, Hale, Macon, Montgomery, Perry, and Sumter, Alabama, and Clay, Jasper, Monroe, Noxubee, Lowndes, Oktibbeha, Pontotoc, and Prentiss, Mississippi. These reports are accompanied by soil maps showing the location and extent of the Houston clay and associated soils.

spicuous groves of mixed oaks and hickory occur throughout the prairie belt on the "post-oak land" or "post-oak prairie," representing occurrences of such soils as the Oktibbeha and Orangeburg.

GRASSES.

Much of the unused Houston clay supports a growth of valuable wild prairie grasses, Bermuda and Johnson grass, lespedeza, and melilotus.

NATURAL PRODUCTIVENESS.

The Houston clay unquestionably constitutes inherently the most productive upland soil of the Gulf Coastal Plain east of the Mississippi River. As an illustration of its extraordinary productiveness and durability, it needs only to be cited that much of this land, after 50 or 75 years or more of practically continuous cultivation to cotton and corn without the addition of any kind of fertilizer, to-day frequently produces three-fourths or sometimes even a bale of cotton to the acre. Hilgard says:[1]

> The prairie lands of northeastern Mississippi were among the first occupied by settlers, both on account of their great fertility and the comparative ease with which they could be taken into cultivation.

Dr. E. A. Smith,[2] in discussing the black prairie land, says:

> The unbroken surface of this region is due to the homogeneous character of the limestone, which suffers waste equally on this account over considerable areas; hence the entire absence of ravines and other abrupt irregularities. The effects of this feature upon the soil must be obvious—nothing escapes, every particle of organic matter remains on the surface or is removed but a short distance to be again deposited. A soil formed under such circumstances and from such a material as this—rotten limestone—can not fail to possess extraordinary fertility.

It should not be concluded, however, that the Houston clay does not show depreciation in crop yields under hard and careless usage, for on much of this soil, especially that of the more sloping areas, where there is a continual removal of soil through erosional processes, as well as upon the phase in which there is only a shallow covering of soil proper over the light-colored chalky subsoil, yields have been lowered considerably under the prevailing system of farming, in which systematic crop rotations have not been followed and no provision has been made to arrest erosion. Such inefficient and wasteful methods have gradually decreased the organic matter content and consequently increased the tendency of the soil to bake and compact in dry weather. The unfavorable structural conditions thus induced lessen the soil's capacity to conserve moisture and otherwise unfit the land for best crop growth. Continued productiveness in case of the dominant and better phases of the Houston

[1] Cotton Production, Tenth Census, part 1, pp. 215–216.

[2] Report on the Geology of the Coastal Plains of Alabama, p. 828, Geological survey of Alabama.

clay has been favored to an exceptional degree by the presence of lime in sufficient quantities to effect desired flocculation of soil particles and to change organic matter into an excellent, durable form. In this way highly desirable structural conditions have been brought about—conditions favoring the absorption of large quantities of rainfall and the retention of sufficient moisture to insure steady plant growth through dry seasons, and at the same time reducing the danger of baking to a minimum. In addition to its favorable action upon the structural arrangement of the soil particles and upon the condition of the organic matter, the lime present probably also is beneficial in another rôle—the correction or amelioration of insanitary or toxic conditions resulting from continued production of the same crop under inefficient methods of cultivation.[1]

Applications of lime in the form of broken limestone from the underlying formation have given good results when tried occasionally, especially on the more clayey phases or on those areas somewhat mixed with other less calcareous soils.

NEED OF CROP ROTATION.

Experience has demonstrated that there is little or no land that can better withstand hard usage and continued cultivation to one crop than this prairie soil. Nevertheless, certain crop rotations are markedly beneficial, and, indeed, are very essential to the most profitable utilization of those fields having a shallow depth of soil, especially in the production of clean cultivated crops. The introduction of a legume, such as alfalfa, melilotus, lespedeza, bur clover, or cowpeas, invariably proves beneficial to succeeding crops like corn, cotton, grain, and grass. The effects of legumes in increasing the yields of subsequent crops are surprisingly lasting. A good share of this improvement comes from the influence of added organic matter, the shading of the land, the loosening effect of the roots on the subsoil, and the storage of atmospheric nitrogen through the action of bacterial life in the root nodules. Beneficial results of such crop rotations probably also accrue to the land through a modification of the plant environment, resulting in an improvement in the sanitary condition of the soil.

In the past little systematic crop rotation has been followed on the Houston clay, and little or no attention has been given to the maintenance of a proper supply of organic matter. This, considered in connection with the fact that manures or fertilizers have never been used extensively, speaks well for the durability of those fields that still produce good crops after continuous cultivation for upward of a century. But the fact must not be lost sight of that greater

[1] See Bulletin No. 40, Bureau of Soils.

average yields can be secured easily by the practice of suitable crop rotations, especially those including the legumes. The most severely impoverished fields and eroded areas can be wonderfully and immediately improved by plowing under crops like melilotus, lespedeza, and cowpeas.

CROP ADAPTATION AND YIELDS.

As already stated, the Houston clay is well adapted to cotton, corn, grass, and alfalfa. Most of the type has been under cultivation for many years, and until recently its management has not been directed along lines conducive to high average yields, main dependence having been placed, ill-advisedly, upon the inherent fertility of the soil. Usually corn yields from about 20 to 60 bushels, cotton from one-third to 1 bale per acre, and oats 20 to 60 bushels per acre, according to variation in seasonal conditions and methods of management.

The soil is admirably adapted to Johnson and Bermuda grass. Yields of from 1 to 2 tons per acre of excellent Johnson-grass hay are secured continuously from easily sodded fields. (Pl. V, fig. 2.) This hay is highly nutritious and finds a ready market at profitable prices. Both Johnson and Bermuda grass take such thrifty hold and spread so rapidly that many farmers look upon them as serious pests, and it is a common practice to skip over patches occupied by them on account of the resistance they offer to plowing. (Pl. V, fig. 1, and Pl. VI, fig. 1.) Through gradual encroachment the sod sometimes spreads over entire fields, finally causing their abandonment for intertillage crops and their utilization for hay lots and pasture instead. Either of these grasses can be eradicated by frequent shallow cultivation, following close grazing or smothering by some thick-growing crops, such as sorghum, millet, cowpeas, or melilotus.[1] Profitable returns are also secured from grazing both Johnson and Bermuda grass. Not infrequently fields abandoned to Johnson grass give more profitable returns than when the land was used for the production of cotton and corn under inferior methods of cultivation. In the commercial production of Johnson-grass hay, where the best quality and maximum yields are sought, it is a good practice to break the soil shallow every two or three years after danger of freezing has passed. This can be done advantageously with a two-horse turning plow. A spike-tooth harrow run over the field following such cultivation leaves it in good condition for mowing. Sweet clover (*Melilotus alba*) and lespedeza (*Lespedeza striata*) grow wild over much of the type. Both of these are good hay crops, and in addition are excellent soil improvers. They spread rapidly over badly eroded areas and can be used to great advantage in building up impoverished and washed fields. In cases of badly run down and eroded areas one of these or

[1] See Farmers' Bulletins Nos. 279 and 102 (p. 10).

FIG. 1.—VIEW SHOWING THE TOPOGRAPHY OF TYPICAL HOUSTON CLAY ("BLACK PRAIRIE"), NOXUBEE COUNTY, MISS.

FIG. 2.—VIEW SHOWING IN FOREGROUND CRACKING OF HOUSTON CLAY CAUSED BY SHRINKING OF SOIL UPON DRYING OUT.

This tendency of the soil to crack aids in the formation of a natural mulch.

FIG. 1.—A TYPICAL BOIS D'ARC (OSAGE ORANGE) HEDGE ALONG ROADSIDE ON HOUSTON CLAY.

This soil is remarkably well adapted to this tree, which has been used extensively in hedges as a substitute for fences. Such hedges are coming into disfavor on account of the tendency to spread out into the field.

FIG. 2.—ALFALFA ON HOUSTON CLAY CLAY COUNTY, MISS.

Crop in proper stage for cutting.

some other crop, such as cowpeas, bur clover, vetch, or rye, should be plowed under to supply needed organic matter prior to reseeding the land. In a few years, or as soon as the right proportion of organic matter has been incorporated with the soil, areas practically worthless for cultivated crops can be made to produce fair to good yields of corn, cotton, oats, and even alfalfa. During the course of such treatment lespedeza and melilotus usually can be cut for hay after the first crop or two has been plowed under as green manure. Under this treatment of incorporating vegetable matter the soil becomes darker in color. Some almost white fields have thus been brought to look quite like the lighter colored phases of the Houston clay.

Vetch, cowpeas, soy beans, bur clover, sorghum, and millet are forage crops that can be grown profitably in connection with stock raising or dairying. Good yields of wheat can be secured, but at present this crop has no important place in the agriculture of the region.

SUITABLENESS TO STOCK RAISING.

The Houston clay offers excellent opportunities for stock raising and dairying. The raising of hogs in connection with the growing of alfalfa and other forage crops can be made a profitable specialty.

CULTIVATION.

Notwithstanding the good structural properties, unusual for so heavy a soil, it is not advisable to plow the land when wet enough to be decidedly sticky, as with subsequent dry weather there would likely result from such treatment more or less harmful baking, particularly in those fields where the lime and organic matter content is low. Mistakes of this kind are not likely to be made often for the reason that the extreme adhesiveness of the soil makes plowing with even a slight excess of moisture present very difficult. Fall plowing to a depth of 6 to 8 inches or more is good practice, making it possible to prepare in the spring an excellent seed bed for cotton and corn.

Either level or slight ridge cultivation should be employed for both corn and cotton. Moderately deep plowing, 5 or 6 inches, with thorough harrowing, will suffice for oats, wheat, grass, vetch, melilotus, bur clover, millet, and lespedeza. Cowpeas and sorghum do not especially need a very finely pulverized seed bed, but the land should be thoroughly broken to a depth of 5 or 6 inches. The power of the soil to store and retain moisture is greatly enhanced by deep fall plowing and by liberal incorporation of vegetable matter. Conservation of soil moisture during the growing season is best effected by frequent shallow cultivation. Deep fall plowing, followed with a winter cover crop—oats, rye, or vetch—and the maintenance of a good organic matter content contribute to the soil's power of resisting

erosion. Some of the steeper slopes should be used largely for sod crops as the least expensive method of checking or preventing erosion. Bermuda grass, melilotus, lespedeza, and bur clover are well suited for this purpose

PRESENT USE OF TYPE.

The greater part of the Houston clay under cultivation is still being utilized in the production of cotton, corn, and Johnson-grass hay, but the growing of alfalfa is gradually being extended, and the crop promises to be one of the most, if not the most, important produced on this type of soil; for, indeed, the Houston clay is an alfalfa soil, par excellence. Its silty clay texture and good structure favor the retention of an adequate supply of moisture, combining at the same time sufficient permeability for unretarded root development. The drainage condition is excellent. There is no danger of any injury to the root system on account of poor underdrainage, inasmuch as the water table rarely comes within 10 feet of the surface, and the subsoil seldom presents the cold, wet condition usually considered inimical to continued healthful growth of the plant. Also the prevailingly high lime content is decidedly favorable to alfalfa, which is one of the lime-loving plants. The fact that Melilotus[1] thrives on the soil, coupled with the good growth made by alfalfa under favorable seasonal conditions, where seeded on properly prepared land not infested with noxious weeds, attests the presence of the proper bacterial flora for alfalfa in at least a part of the type.

In the light of the unquestionably excellent adaptation of the Houston clay to alfalfa, it seems inevitable that there will be a gradual spreading of the crop over the type. Already it has attained importance in a number of sections, as in the vicinity of West Point, Columbus, and Macon, Miss. Most encouraging results have been secured at the Canebrake Experiment Station at Uniontown, Ala.

FERTILIZERS.

Very little commercial fertilizer is used on the Houston clay, in fact, such good crops have been secured without the addition of manures that there has been little incentive even for their use in an experimental way. Continued usage of the land, however, under methods not always insuring proper provision for the prevention of erosion and the maintenance of an adequate supply of vegetable matter in the soil, has brought some fields into a somewhat impoverished condition, and, as elsewhere pointed out, there is need to look more carefully to the matter of adding needed organic matter such as can be readily and cheaply supplied by growing the legumes in rotation with other crops.

[1] "It has been found that soil from around the roots of the sweet clover (*Melilotus alba*) is quite as effective [for inoculation] as alfalfa soil." Farmers' Bulletin No. 339, p. 17.

Where such crops as cotton and corn have had the most important place in the system of farming followed, it is believed that certain fertilizer mixtures can be profitably used to restore productiveness in case of deteriorating fields by encouraging good growths of such soil improving crops as the legumes. This question has received the attention of the Alabama Canebrake Experiment Station at Uniontown, where experiments have been made which indicate profitable results to be had in the production of cotton and other crops by the use of varied fertilizer mixtures. These experiments point strongly toward the profitableness of nitrogenous fertilizers, especially nitrate of soda in combination with cottonseed meal and potash. Phosphatic and potash mixtures alone appear to have been of little or no value.[1]

On those farms where alfalfa is given a prominent place, especially as a basis for stock raising, it is not likely that commercial fertilizers will be needed to any considerable extent. Other crops, as cowpeas, bur clover, melilotus, and vetch, can be fitted nicely into rotations that will not only count for soil improvement but provide forage for an increased production of stock and milk. It is believed that this wonderfully productive prairie soil can in this way be used very much more profitably than it has been in the past, under the system in which cotton and corn are the chief if not the sole crops grown.

VALUE AND AREA UNDER CULTIVATION.

At one time or another most of the black prairie land has been under cultivation or used for pasture and native hay. For a considerable period following the civil war much of it was thrown out of cultivation. The area under cultivation is now increasing, and, in fact, only within the last few years has the public begun to appreciate its real worth. It is being cultivated with increasingly better methods and with more regard for the production of those crops to which it is best adapted.

The value of the Houston clay varies, according to location and regional agricultural development, from about $20 to $75 an acre. In some sections very little is on the market, while in other localities more distant from the advance lines of the boll weevil, and where the adaptation to alfalfa has not been strongly impressed upon land owners, some tracts can still be bought at low figures. Within a radius of 6 miles of West Point, Miss., where the alfalfa acreage is being rapidly extended, the type can not be bought for less than $50 to $75 an acre, and much of that already seeded to the crop is held at even higher prices. Good black prairie land favorably situated with respect to market or shipping station rents for $3 to $5 an acre.

[1] Bulletin No. 27, Alabama Canebrake Experiment Station, pp. 10–11.

SOILS ASSOCIATED WITH AND CLOSELY RELATED TO THE HOUSTON CLAY.

Several types of soil have been mapped in the prairie belt which are closely related to the Houston in that they are derived either directly or indirectly from the rotten limestone. These are the Houston chalk, Houston loam, and Trinity clay.

HOUSTON CHALK.

Inasmuch as the Houston chalk represents in the main areas that were formerly Houston clay, a brief discussion of this soil is given especially to emphasize the problem of erosion in its relation to the black prairies of Alabama and Mississippi.

The Houston chalk, locally styled "lime hill land" or "bald prairie land," represents exposures of the more or less disintegrated Selma chalk. This soil is developed in relatively small and scattered patches on the steeper slopes throughout the calcareous prairie regions of Alabama and Mississippi. The type is the result of severe erosion, through which the removal of the natural dark-colored clay (Houston clay) derivative of the Selma chalk has nearly or quite kept place with weathering. In places, there has accumulated a thin stratum of light-grayish to nearly white soil of chalky characteristics. Over the main portion of the type, however, there is little or no soil, and the land in its present condition is practically worthless for the production of ordinary farm crops (Pl. IV).

While most of the surface material is fairly compact, it is considerably softer than the unaltered blue limestone that underlies the region, although even the latter is exposed here and there in the most severely eroded areas. The Houston chalk areas, owing to their light color, are very conspicuous features in the landscape, resembling scars upon the surface of the more extensively developed Houston clay.

Some areas are so gullied that there is slight probability of their reclamation for agriculture in the near future. Indeed, the entire type would be classed as nonagricultural land but for the readiness with which melilotus and lespedeza spread over the land when once started. Good pasturage and some hay can thus be secured.

Much of the Houston chalk, however, can be reclaimed for use in growing other crops, including cotton, Johnson grass, and even alfalfa. As soon as melilotus or lespedeza has become well established the weathered rock material is held in place and the accumulation of organic matter in the material thus retained effects with surprising rapidity the formation of a soil with properties fitting it for the production of the crops mentioned. This soil-forming process can be materially accelerated by plowing under either melilotus or lespedeza. In view of the ease with which these legumes take hold

of the "lime hill" soil and their efficiency in checking erosion, there is absolutely no excuse for the further encroachment of these washed areas upon the valuable Houston clay or, for that matter, for allowing areas already eroded to stand idle and unprotected from further ruinous waste.

Cedar trees are of frequent occurrence on the Selma chalk, where they often grow in an astonishingly thin stratum of soil. Locust also is a common tree upon this land. Both are lime-loving species.

HOUSTON LOAM.

There are some scattered areas of the Houston loam in the Black Belt, but their small extent make them of little importance; in fact, this type has been mapped only in Clay County, Miss., near West Point.

This soil is very closely associated with the Houston clay. Owing to its coarser texture, it is easier to plow and can be handled under a wider range of moisture conditions. The soil consists of a grayish-brown loam containing considerable fine and very fine sand. The subsoil, which is usually encountered at a depth of about 8 to 10 inches, is a light-gray loam to silty clay, like the typical subsoil of the Houston clay.

"In formation the Houston loam seems to be closely associated with the Houston clay, apparently being derived largely from the Selma chalk formation, although modified by more recent sand deposits."[1] The soil is calcareous, as would be expected from its origin.

It is well adapted to corn, cotton, alfalfa, lespedeza, melilotus, cowpeas, bur clover, and oats.

TRINITY CLAY.

CHARACTER OF SOIL.

In the bottoms of streams heading in or traversing the Selma chalk formation in Alabama and Mississippi there occurs an extremely productive dark-brown to black alluvial soil which has been given the name Trinity clay.[2] This soil in its typical development consists of a dark-brown to black clay loam to clay 10 to 15 inches deep, underlain by a plastic clay usually dark-gray to black in color.[3] In places the subsoil color is drab or gray with slight brownish mottlings.

[1] Soil survey of Clay County, Miss.

[2] Named from the Trinity River of Texas, in the bottoms of which stream the type is typically developed.

[3] The average results of mechanical analyses of representative samples of soil and subsoil of the Trinity clay from Alabama and Mississippi are given in the following table:

Mechanical analyses of Trinity clay.

Section.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Soil	0.0	2.3	1.5	8.7	4.7	45.2	37.5
Subsoil	.0	1.7	.8	8.5	6.2	45.7	36.9

Almost invariably the soil is rich in organic matter, even where it has been under cultivation for long periods, and the lime content is generally considerable.[1] In consequence of such favorable composition a good condition of tilth can be easily maintained, if plowing is done when the soil is not so wet as to be decidedly sticky and not so dry as to offer any considerable resistance to the plow. Plowing when the soil is excessively wet is likely to result in an undesirable structure or puddled condition if followed by dry weather, while clods formed in plowing the thoroughly dried out, hardened soil are sometimes difficult to pulverize. However, it is much easier to restore favorable structural conditions in this type than in other soils containing the same amount of clay, but less organic matter and lime, such, for example, as the Oktibbeha clay. With deep fall plowing it is much easier to secure a well-pulverized seed bed the following year in those areas not subject to frequent overflow.

When wet the Trinity clay is very sticky and plastic, but on drying it usually cracks into a peculiar crumbly state, a result of the high content of lime and organic matter, thus tending to form a natural mulch. This tendency to crack into small soil aggregates or particles has given rise in some sections to the local designation of "buckshot land." Under proper cultivation the soil possesses a rather coarse granular structure which is not readily changed by rains, and where frequently stirred it retains favorable amounts of moisture within a few inches of the surface, even through prolonged droughts.

ORIGIN OF SOIL.

The Trinity clay occurs as first bottoms along streams rising in or flowing through the black prairie region, and the material forming the type in Alabama and Mississippi is derived largely through wash from the Selma chalk and its soil-derivative, the Houston clay.

In color the soil of the Trinity clay averages darker than the black prairie land from which it is derived, except in the vicinity of the exposed nearly white rotten limestone, where there has not been sufficient accumulation of organic matter or reworking with the already darkened bottom land to impart the dominant black color. Some small areas bordering the limestone exposures have a light-gray color. These have been included with the type because it is impracticable to separate areas of such small extent. A considerable proportion of the Trinity clay has a brownish color somewhat like that of other alluvial soils, not including material from the Houston, for instance, the Ocklocknee soils. This brownish phase usually includes considerable wash from the Oktibbeha or post-oak lands, and although

[1] One sample from Montgomery County, Ala. (mapped as Yazoo clay), analyzed 0.74 per cent calcium carbonate ($CaCO_3$) in the soil and 2.30 per cent in subsoil. The subsoil of another sample contained 13.53 per cent lime. Soil Survey Montgomery County, Ala., Field Operations of the Bureau of Soils, 1905.

it may not contain as much lime as the darker colored phase made up mainly of wash from the Houston soils, it does carry sufficient lime to produce a crumbly structure. There is little difference in the crop value of the several phases of the Trinity clay.

DRAINAGE.

A considerable proportion of the Trinity clay is subject to annual overflow, while other areas are not inundated oftener than once in every three to six years. Overflows usually occur during the winter and early spring months, although crops on the low areas near the stream channels are liable to damage from freshets later in the season.

Although the Trinity clay occurs in comparatively shallow stream bottoms, strikingly flat in surface configuration, the drainage is good over much of the type. Some of the flatter areas and most of the swales and depressions need ditching. Tiling has not been extensively attempted. It has been claimed that the subsoil is too heavy and too plastic in structure to admit of effective tile drainage. Nevertheless, other soils containing as much clay in the subsoil portion as the Trinity have been effectively drained by the use of tiles, and it is believed that with proper placement tile drainage could be successfully installed on this type. There is little question that the system would prove profitable in many instances, especially where the land is intended for alfalfa.

OCCURRENCE.

The bottoms of many streams in and issuing from the black prairies,[1] especially the broader areas, are exclusively occupied by this soil, but occasionally the type occurs as comparatively narrow marginal strips along the foot of slopes bordering, or in the vicinity of areas of the Houston clay, the Houston chalk, or exposures of the parent rock. The width of the Trinity clay bottoms varies with the size of the stream from a few rods along the smaller branches to approximately 2 miles along the rivers and larger streams, as for example in places along Catoma Creek in Montgomery County, Ala. The position and relative extent of the Houston clay and the Trinity clay will be seen in figure 2, showing typical conditions existing in Montgomery County, Ala.

CROP VALUE AND CROP ADAPTATION.

The type was originally forested with oak, sweet gum, hickory, and other deciduous trees. A very large proportion of its area is now under cultivation, mainly to corn and cotton.

Probably a more fertile soil could not be found than the Trinity clay, representing as it does stream-deposited material washed chiefly from the extremely productive black prairie land. Alluvial

[1] There is very little Trinity clay in the lower prairie belt.

soils where good drainage can be effected are usually more productive than the uplands from which they are derived through water transportation, a fact which is mainly due to the higher organic matter content of the bottom-land types, their greater retentiveness of moisture, and the more homogeneous mixture of the fine and coarse soil particles from the surface downward.

The fact that the type is subject to overflow is a decided disadvantage from one point of view; from another it is an advantage in

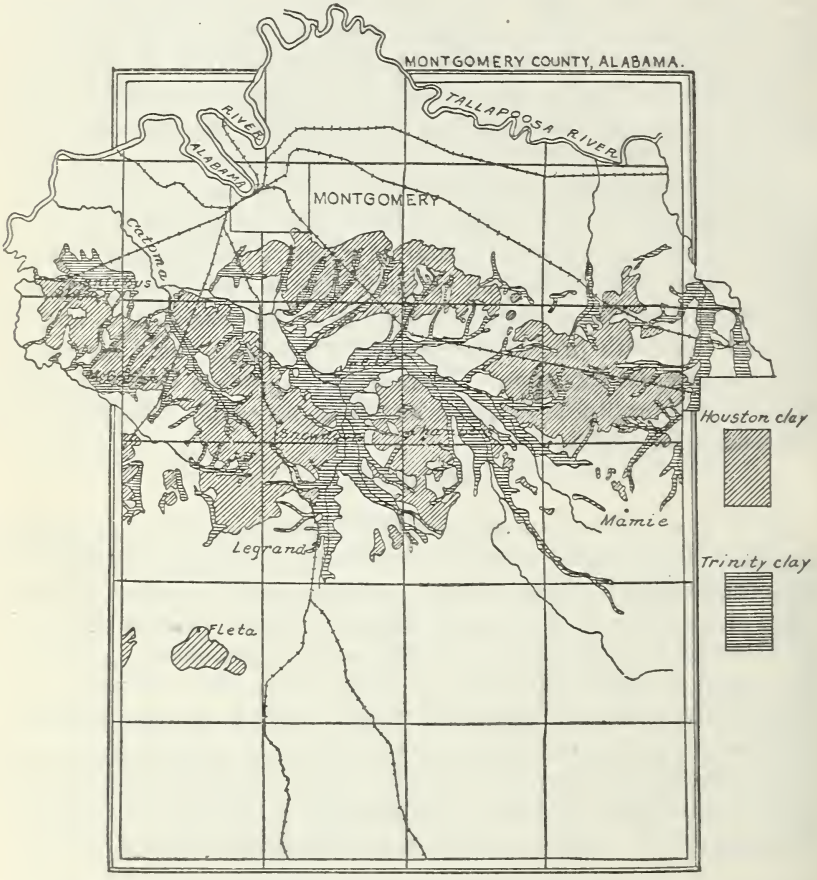

FIG. 2.—Location and relative extent of Houston clay and Trinity clay in Montgomery County, Ala.

that fresh soil material of excellent quality is deposited from time to time, so that it is not likely that manures will ever be needed except perhaps for cotton. Experiments with cotton at the Alabama Canebrake Experiment Station on "black bottom land" gave profitable returns from the use of nitrate of soda and either negative results or only small profits from various other applications.[1]

[1] See Bulletin No. 27, Alabama Canebrake Experiment Station, p. 11.

SECOND CUTTING OF ALFALFA ON HOUSTON CLAY; YIELD A LITTLE OVER 1 TON PER ACRE.

A total of five cuttings, averaging 4½ tons per acre, were made in this field the year this picture was made (1907). Clay County, Miss.

Cotton yields from ½ bale to 1¼ bales upon the Trinity clay and corn from 40 to 75 bushels per acre, without the use of any fertilizers. The large growth of cotton gives high yields in spite of a tendency of the crop to fruit lightly and to mature slowly.

Forage crops, such as cowpeas, melilotus, and Japan clover, give heavy yields where the drainage is good. There are also a number of native grasses that afford good pasturage. Johnson and Bermuda grass make a luxuriant growth, and often become a serious hindrance to the cultivation of other crops unless checked in the earlier stages of their development.

Where good drainage is insured, the Trinity clay is even better adapted to alfalfa than the Houston clay. Alfalfa fields should be insured against overflow, or at least prolonged overflow, during the growing season.[1] The crop can be successfully grown on a large part of the type without any provision against overflow, although "back furrowing" or cultivation on raised beds ("lands") may be advisable. In the lower situation where overflow water stands longest the alfalfa fields should by all means be protected by dikes or embankments. These can be constructed at comparatively low cost as rather low embankments would suffice in most cases, the overflow being in most cases rather shallow.

VALUE.

It is not practicable to give the selling price of the Trinity clay. It is closely associated with uplands and is rarely if ever offered for sale separately. Usually when associated with the Houston clay no difference in the acreage valuation is made. As with the black prairie land, its value is gradually advancing.

DISTRIBUTION.

The following table shows the distribution and extent of the Trinity clay in the various counties of Alabama and Mississippi so far covered by soil surveys.

TABLE 2.—*Extent and distribution of Trinity clay, as determined by surveys to July 1, 1910.*

ALABAMA.

County.	Acres.	Square miles.
Montgomery [2]	50,624	.....
Hale	27,452	.....
In other counties under other type names, part estimated as Trinity clay	[3] 56,600	.....
Total	134,676	241.5

[1] "Alfalfa is often killed by overflow from streams. During its growing period it will not usually withstand more than 24 hours of complete submergence, or more than 48 hours of partial overflow. During the dormant period of winter, however, fields have been known to remain under flowing water for 2 weeks without serious injury." Farmers' Bulletin No. 339, p. 10.

[2] Mapped as Yazoo clay.

[3] Estimated 9,700 acres mapped as Meadow in Macon County, 25,000 acres mapped as Ocklocknee clay in Dallas County, 2,000 acres mapped as Meadow in Perry County, and 20,000 acres mapped as Waverly loam in Sumter County.

TABLE 2.—*Extent and distribution of Trinity clay, as determined by surveys to July 1, 1910*—Continued.

MISSISSIPPI.

County.	Acres.	Square miles.
Monroe	27,904	
Clay	20,032	
Oktibbeha[1]	7,616	
Noxubee	23,168	
Total	78,720	114.9

[1] Mapped as Wabash clay.

In addition to the 213,396 acres so far mapped there are in the unsurveyed portion of the prairie region probably in the neighborhood of 100,000 acres of Trinity clay.

SOILS ASSOCIATED WITH BUT NOT CLOSELY RELATED TO THE HOUSTON AND TRINITY SOILS.

As already mentioned the Houston clay is closely associated in occurrence with other upland soils having very different characteristics and agricultural values. Also, other types of soil than the Trinity clay are encountered in the flood plains of streams traversing and heading in the black prairie belts, though their extent compared to that of the Trinity clay is relatively less than that of the other upland soils as compared with the area of the Houston clay. The association of the Houston soils with other types is well illustrated in Hale County—a typical section of the black prairie belt. Figure 3 shows the distribution of soils over a part of this county.

It is considered advisable to include brief descriptions of the most prevalent of these associated soils.

OKTIBBEHA SOILS.

The Oktibbeha series of soils is extensively developed in the black prairie belts of Alabama and Mississippi in close association with the Houston clay. The surface soils vary from grayish sandy material to yellowish-brown clay, while the subsoils consist of brown or brownish-yellow, rather compact, plastic clay, often mottled with red and sometimes with grayish colors.

In the deep subsoil a mottling of gray, red, yellow, and brown is frequently seen. The greater part of these soils is derived from material which may represent either a deposit immediately overlying the rotten limestone formation or a phase of the formation itself.[1]

[1] The possibility of the Oktibbeha soils representing a derivative of the Selma chalk or rotten limestone formation has been advanced. The question of the origin of these soils has not been definitely settled by geologists, but the wide variation of the soils in color and other features, as well as agricultural value, from the Houston clay, which is unquestionably a Selma chalk derivative, is strongly indicative to the writer of an origin either from a younger formation or a distinct phase of the Selma chalk. See Bulletin No. 1 Mississippi geological survey, p. 42.

Generally the white chalky material is encountered at from 3 to 10 feet below the surface and not infrequently exposures are seen. Representing, as it appears, remnants of an older or overlying deposit left by erosion, the Oktibbeha material naturally thins out toward the contact with the Houston clay. Patches of Houston clay often occur so intricately associated with the members of the Oktibbeha series as to give rise to a peculiarly spotted appearance to the land.

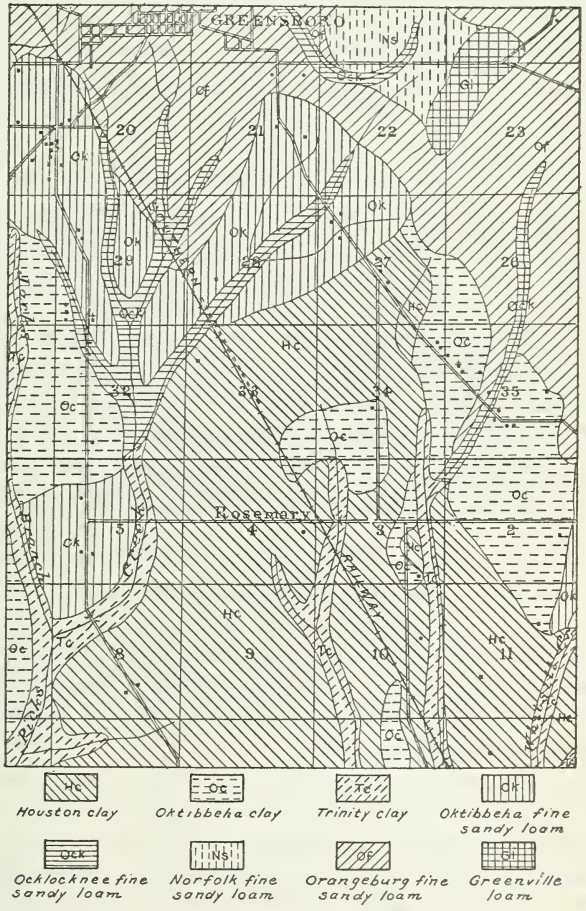

FIG. 3.—Part of Hale County, Ala., soil map, showing association of Houston clay (black prairie land) with other soils.

Such areas are known as "mixed prairie," "mixed post-oak land" or "bastard post-oak land," accordingly as the Oktibbeha or Houston soil predominates. Where the Oktibbeha is associated in patches with the light-colored Houston chalk and the dark Houston clay the land is styled "calico prairie."

A distinguishing characteristic of the Oktibbeha group of soils is the heavy growth of hardwood on uncleared areas. Oaks (principally

the post oak), hickory, and a few other species constitute the usual forest growth. From the prevalence of this growth has come the local designation "post-oak land" or "post-oak prairie" applied to the soils of the series.

The surface of the Oktibbeha soils varies from flat to gently rolling. Drainage is generally good, except in the more nearly level areas where water sometimes stands after rains.

The clay, clay loam, silt loam and fine sandy loam are the principal types. With the exception of the fine sandy loam tillage of these types is rather difficult owing to the close, compact nature of the soil. Deep fall plowing to afford better aeration, and the turning under of vegetable matter in the form of cowpeas, vetch, clover, and rye, are effective in bringing about a better tilth.

The Oktibbeha soils are usually considered inferior in value to the Houston clay. Nevertheless, good yields of a number of crops are secured by careful farmers. Cotton and corn are the crops most commonly grown. The clay loam especially is a very good cotton soil. Bermuda and Johnson grass, lespedeza, melilotus, vetch, bur clover, and crimson clover do well on these soils. Recently some very good crops of wheat have been grown on the clay and clay loam.

The Oktibbeha soils are not very well adapted to alfalfa, partly because of the tendency of the soil to compact and harden after rains. By carefully preparing the seed bed a good stand can be secured, but too often the plants show a retarded growth or die out in the second or third year.

Manurial applications are decidedly beneficial to most crops adapted to these soils, green manuring crops, barnyard manure, and fertilizers relatively high in phosphoric acid giving especially good results. Although these lands contain considerable lime, there are places where applications of lime would very likely benefit them. With heavy application of lime, something like a ton per acre, it is believed alfalfa could be made a profitable crop.

The flat areas need drainage as water often stands on the surface following wet spells. By ditching or tiling most of the more nearly flat areas could be made much better suited to agriculture.

The Oktibbeha soils range in value from about $15 to $40 an acre, according to location and type. These are valuable agricultural soils and their worth is being appreciated more and more. They are naturally fertile and only need careful handling to produce good crops.

SUSQUEHANNA SOILS.

The Susquehanna soils, as developed in the Black Prairie regions of Alabama and Mississippi, range from grayish fine sandy loam to stiff, red clay, overlying a very plastic impermeable dull-red clay more or less mottled with gray. These soils were originally timbered

with oak, hickory, and some other hardwoods. They are locally known as "red post-oak land" or "red prairie."

The Susquehanna soils are derived apparently from a heavy clay formation, which was deposited over the Selma chalk and later partially removed by erosion.[1]

The surface features vary from choppy hills and rolling areas to areas almost flat. Drainage is fairly good over most of the type, in places the run-off being so rapid as to cause damaging erosion.

The fine sandy loam and clay are the most important members of the series occurring in the black belt. These soils are considered inferior to those of the Oktibbeha series, and are less extensively cultivated. With liberal incorporation of vegetable manures the better lying areas of the fine sandy loam can be brought into fairly good condition for cotton, corn, and forage crops. Owing to the impervious nature of the clay type much of the rainfall runs off rapidly, and crops suffer severely in dry seasons for lack of moisture. The intractable character of the land makes it difficult to work up a deep seed bed, so that only shallow-rooted crops are adapted to the type. By growing cowpeas and gradually deepening the plowing, the soil eventually can be brought into fairly good condition for cotton. The structure of the soil may also be improved by applications of lime which tend to flocculate the soil grains and thus to bring about a looser structure. Bermuda grass does very well and affords good grazing besides efficiently checking erosion. Lespedeza and carpet grass also give very fair results.

ORANGEBURG SOILS.

The Orangeburg group of soils comprises the gray to brown sandy soils overlying bright-red, friable, sandy clay subsoils. These soils are derived chiefly from the Lafayette formation and occur throughout the prairie belts of Alabama and Mississippi as patches or remnants overlying the Selma chalk formation. The topography varies from rolling to hilly. Occasionally hills occupied by Orangeburg soils stand out as conspicuous topographic features in the gently rolling Houston clay. The distinctive forest growth is mixed hardwood and pine. With good drainage and the excellent structured sandy clay subsoil, the Orangeburg soils, where well supplied with vegetable matter, give good yields of a wide range of crops, including cotton, corn, forage crops, peaches, small fruits, melons, and many vegetables. The better lying areas are highly prized for cotton, corn, forage, fruit, and vegetables. The fine sandy loam and sandy loam types are the most important.

[1] As with the Oktibbeha soils the geological horizon of the parent formation has not been definitely determined.

Erosion is very destructive to the Orangeburg soils, especially where clean cultivation is conducted on the steeper slopes. Cowpeas or other vegetable matter plowed under materially assist in reducing the tendency to wash. The steeper areas should never be brought under cultivation, while the moderately steep areas mostly should be used only for fruit or for pasture, sodding to Bermuda grass.

STREAM BOTTOM SOILS ASSOCIATED WITH TRINITY CLAY.

The most important of the stream bottom soils associated with the Trinity clay are members of the Ocklocknee and Bibb series. These not only differ more or less from the Trinity clay in their color and structural characteristics, but also in origin. The component material is here derived principally from upland soils other than the Houston, including prominently the Orangeburg, Oktibbeha, Susquehanna, and Norfolk series.[1]

OCKLOCKNEE SOILS.

The Ocklocknee series is characterized by the prevailingly brown color and mellow structure of the deep surface soils and the light-brown to mottled subsoils. There is considerable range in the color and structure of the subsoil. Along the larger streams it is more uniformly brown and fairly friable, while along the lesser streams it is yellowish, more or less mottled with gray, and somewhat plastic.

The sand, fine sandy loam, loam, clay loam, and clay are the most important types. These are alluvial soils and all subject to overflow. The better drained areas, when not seriously overflowed during the growing season, produce excellent yields of corn, cotton, and forage crops. Very valuable agricultural lands are comprised in the Ocklocknee series.

BIBB SOILS.[2]

The Bibb series includes poorly drained, light-gray to white, first bottom lands. The soils are usually compact and have an unproductive appearance, while the subsoils, which are light-gray or nearly white mottled with yellow and brown, are plastic and impervious. In origin of material the Bibb soils are practically identical with the Ocklocknee, the distinguishing difference, the light color and unfavorable structural properties, arising from the very poor drainage

[1] The Norfolk types, characterized by gray soils and friable yellow sandy clay subsoils, are not extensively developed within the black prairie belt, but material from the Norfolk areas is carried by streams heading outside the prairie belt and deposited along with materials from other soils, both within and without the belt, to form the Trinity clay.

[2] These soils have been mapped under the name Waverly. In the future that name will be used exclusively for the light-colored, poorly drained, first bottom soils of the Northern Central States.

conditions to which the material has been subjected since its deposition. Besides being subject to overflow these soils occupy flat and depressed areas having inadequate drainage outlets.

Under present conditions the Bibb soils are of inferior agricultural value and even when given better drainage by ditching they are so cold and dense as to provide a rather poor environment for deep-rooted crops. Wild grasses, such as carpet grass, "water grass," and lespedeza, afford good pasturage under present conditions.

With thorough ditching, deep plowing, and liberal incorporation of vegetable manures very fair crops of corn and cotton are secured. Cotton matures slowly and would probably be benefited considerably by applications of phosphatic fertilizers. The Bibb soils are best suited to pasturage and the production of hay. The fine sandy loam, loam, silt loam, clay loam, and clay are the most important types.

PART II.—ALFALFA ON THE HOUSTON CLAY: ITS CULTURE AND MANAGEMENT.

By M. A. Crosby, *Assistant Agriculturist, Bureau of Plant Industry.*

INTRODUCTION.

The wonderful adaptability of a large portion of the black and gray Houston clay soils of the so-called black prairie belt of Alabama and Mississippi to the production of alfalfa is gradually bringing about an agricultural readjustment of that section.

While alfalfa growing may be said to have long passed the experimental stage in this belt, it is after all comparatively a new crop. The census report for 1899 gives the total acreage of alfalfa in Mississippi as 99 acres, and of this amount only 35 acres are in those counties where the Houston series of soil are to be found. Alabama is credited with a total of 295 acres, of which 178 acres are in the prairie belt. To-day thousands of acres of this prairie belt are devoted to the production of alfalfa, and in many sections it bids fair to become a dominant crop.

The climatic and soil conditions of this belt are such as to make it a region apart from the other alfalfa sections of the country, and much of the available information on alfalfa does not apply to the growing and handling of the crop on the Houston clay soils of Alabama and Mississippi.[1] There is need, therefore, for more specific information on alfalfa culture for this particular region, and it is the aim of this article, in a measure at least, to supply this need. The information contained herein was derived principally by studying the actual practices of alfalfa growers in the prairie belt.

There are many reasons why the soil of this particular belt of land is admirably adapted to the growing of this crop. In the humid eastern States alfalfa generally requires a deep, fertile, well-drained, nonacid soil, and will not succeed on land that is poorly drained or deficient in lime. In this black prairie belt there is a large amount of land that meets practically all of these requirements, and also a large amount that, properly managed, can easily be made to meet them. The soil is naturally deep, fertile, and of good texture; is usually possessed of good natural drainage, or lies in such a manner as to be

[1] For general data regarding alfalfa as a crop see Farmers' Bulletin 339, entitled Alfalfa.

A CHARACTERISTIC VIEW OF HOUSTON CHALK ("BALD PRAIRIE" OR "LIME HILL LAND").

This shows an area from which a former good black surface soil has been washed away. Proper soil management will prevent such erosion. These areas can be reclaimed to agriculture by growing melilotus and lespedeza.

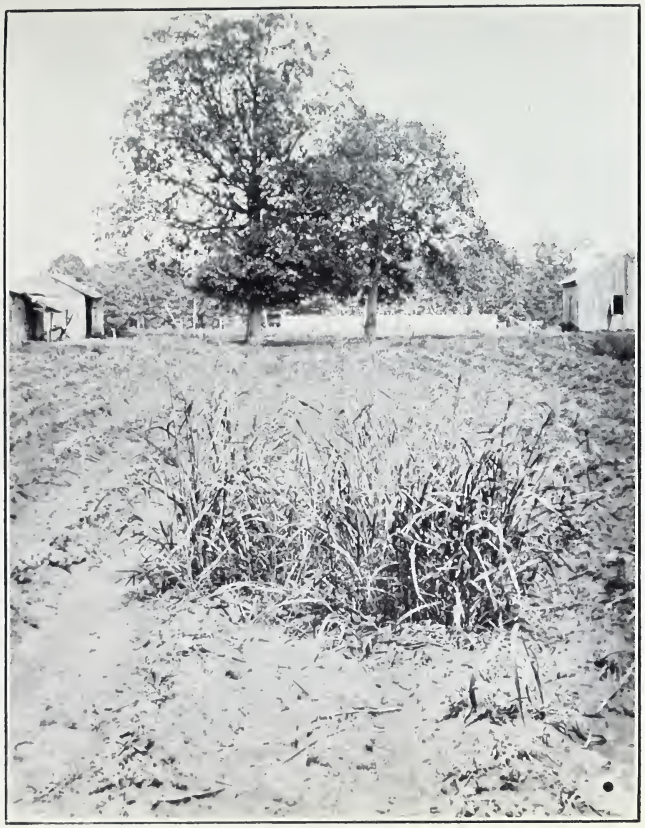

FIG. 1.—A SMALL PATCH OF JOHNSON GRASS IN CULTIVATED FIELD.

Such spots are skipped over in plowing and the grass allowed to encroach upon the cultivated land until the entire fields are given to grass lots. Johnson grass makes a valuable hay.

FIG. 2.—JOHNSON GRASS ON HOUSTON CLAY, NOXUBEE COUNTY, MISS.

Ten-day-old second growth, 18 inches high in foreground. Two cuttings of 1 ton per acre each were secured from this field this year (1910). Johnson grass 5 feet high in middle ground.

readily drained artificially, and usually contains lime sufficient for the needs of the alfalfa crop. These factors make the black and gray soils of this belt the best large area of good alfalfa land east of the Mississippi River and south of the Ohio and Potomac Rivers.

There are, however, some phases of the Houston series of soils on which, for local or other causes, alfalfa growing appears to meet with only indifferent success. In some instances this appears to be due to improper surface drainage, the land lying too flat to permit an excessive fall of rain to be quickly carried away, or to a poor physical condition of the soil brought about by a lack of vegetable matter or humus. In the majority of instances this may be remedied by drainage in the one case or by the incorporation of humus in the soil in the other. In other places the soil is apparently deficient in lime, and although a good stand of alfalfa may be secured it will not thrive, soon turns yellow, and scarcely ever lives more than a year or two. This condition sometimes extends over considerable areas, and again occurs only as small spots in large areas of good alfalfa lands. In some of the localities where this condition prevails, the soil is very black and sticky. Applications of ground lime rock would undoubtedly correct this unfavorable condition and render this soil suitable for the growing of alfalfa. On some of the hills and eroded areas a hard form of the lime rock comes close to the surface, and here it is also difficult to maintain a stand of alfalfa. The lime content of the soil covering this form of rock seems to have been washed away by the heavy rains, and the underlying rock is apparently of such a nature that it is not readily rendered available for the alfalfa plants. When the underlying lime rock is of the soft or "rotten" type, alfalfa will thrive even though the soil covering is only a few inches deep. This form of lime rock may be broken up with a plow and will disintegrate and form soil in a very short time. A crop of melilotus grown on such land will frequently make it very productive in the course of two years.

The following tables show the monthly and annual precipitation, the monthly and annual temperature, and the dates of the first and last killing frosts as recorded at Greensboro and Montgomery, Ala., and Aberdeen and Macon, Miss. These tables show that the climate of this region is as well suited to the production of alfalfa as most of our humid eastern sections, and that the length of the growing season is such as to give from four to six cuttings each year.

Monthly and annual precipitation, in inches.

GREENSBORO, ALA.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1902	4.61	5.28	12.69	2.04	4.91	0.35	2.01	3.36	3.84	5.90	2.89	5.91	53.79
1903	3.50	9.27	4.22	1.31	14.81	5.84	3.67	4.09	1.17	.85	.54	3.03	52.30
1904	5.08	4.62	2.82	1.65	3.00	1.19	6.93	2.78	.72	.08	2.70	2.53	34.10
1905	6.98	7.20	3.43	4.21	4.13	2.91	2.23	9.21	1.80	4.40	1.43	7.56	55.49
1906	4.47	2.43	13.84	1.14	4.69	2.79	5.05	2.51	6.87	4.78	1.96	4.30	54.83
1907	2.37	5.48	2.92	9.71	8.73	2.63	6.80	2.39	5.74	1.50	5.13	7.02	60.42
1908	3.89	5.85	4.31	3.13	6.55	3.26	4.59	5.05	2.05	1.74	1.17	3.09	44.68
1909	1.65	6.61	9.05	8.06	9.21	7.98	3.07	3.19	2.78	.51	.72	4.82	57.65

MONTGOMERY, ALA.

1902	3.73	8.72	8.60	2.09	5.62	1.57	0.43	2.53	2.94	3.24	3.69	5.46	48.62
1903	3.16	11.76	5.21	3.04	6.11	2.63	2.25	4.57	1.06	1.65	1.61	2.94	48.99
1904	4.31	5.78	2.30	1.82	3.47	2.19	3.91	6.81	.72	T.	2.59	3.04	36.94
1905	4.99	6.28	2.61	1.76	9.10	3.05	2.54	2.49	2.83	3.87	1.73	5.98	47.23
1906	4.91	3.80	10.78	.71	4.34	1.59	7.93	1.80	7.80	1.73	1.44	3.30	50.13
1907	1.80	4.51	1.94	6.01	6.27	3.62	4.29	1.07	3.29	1.14	8.75	7.14	49.83
1908	5.05	3.55	5.36	10.96	3.90	.45	4.75	2.72	1.34	3.08	1.88	3.02	46.06
1909	2.13	9.05	16.51	7.40	4.81	7.21	4.21	3.17	1.59	.60	.92	5.78	63.38

ABERDEEN, MISS.

1902	4.37	3.47	9.57	3.35	1.59	2.74	6.76	4.67	3.22	1.56	4.50	6.35	52.15
1903	5.28	8.93	6.82	.75	4.20	3.25	2.09	3.69	T.	1.81	2.49	2.43	41.74
1904	2.88	1.57	4.57	1.05	2.98	2.61	8.43	2.29	1.92	.23	2.97	4.52	35.96
1905	7.12	8.10	4.05	6.38	4.20	5.88	3.41	8.16	3.13	5.18	2.06	5.54	63.21
1906	3.20	1.26	6.02	2.47	6.10	1.79	6.08	2.33	10.27	2.95	3.11	3.72	49.30
1907	1.44	5.97	3.42	6.53	10.48	1.58	7.74	1.87	2.11	1.45	5.33	4.37	52.29
1908	3.89	6.64	5.69	3.88	6.34	3.43	2.15	4.76	1.78	.41	1.50	8.58	49.05
1909	3.35	10.05	7.84	7.90	6.94	7.96	6.59	.61	.75	1.89	.87	4.89	59.64

MACON, MISS.

1902	.....	5.76	10.32	1.04	0.78	0.72	2.25	2.75	4.89	0.94	3.86	4.27	.....
1903	3.43	10.44	3.27	.56	5.81	1.75	1.80	1.07	T.	1.85	2.24	2.62	34.84
1904	3.17	2.02	2.25	1.03	2.92	3.81	5.16	1.80	1.20	.35	.....	.....	.....
1905	.....	.....	.....	4.90	.....	.....	5.50	5.60	1.60	3.41	.....	4.35	.....
1906	2.74	2.38	6.40	.60	4.50	2.93	8.30	.86	8.36	4.49	1.84	5.10	48.50
1907	2.73	3.38	2.22	4.38	8.34	1.10	4.37	2.60	2.60	1.21	3.78	4.09	40.80
1908	3.56	6.83	4.25	5.33	5.11	2.93	5.43	5.74	1.46	.58	.85	6.04	48.11
1909	1.78	5.97	7.66	12.58	9.18	9.51	1.39	2.05	1.32	3.11	.96	3.45	58.96

Normal monthly and annual temperature and precipitation.

Month.	Greensboro, Ala.		Montgomery, Ala.		Aberdeen, Miss.		Macon, Miss.	
	Temperature.	Precipitation.	Temperature.	Precipitation.	Temperature.	Precipitation.	Temperature.	Precipitation.
	°F.	Inches.	°F.	Inches.	°F.	Inches.	°F.	Inches.
January	45.2	5.18	47.7	5.11	41.6	3.99	45.4	4.40
February	51.0	5.36	51.3	5.52	40.9	5.13	43.8	4.17
March	56.0	6.23	57.9	6.38	55.1	5.23	57.1	5.75
April	63.6	4.11	65.2	4.25	62.2	3.75	63.4	3.73
May	72.0	3.76	73.5	3.82	70.6	3.42	72.8	4.35
June	78.4	3.74	79.1	4.21	78.2	4.70	79.2	3.83
July	80.1	3.59	81.0	4.68	80.6	4.72	81.6	5.52
August	79.3	4.85	79.7	4.24	79.4	3.78	80.9	4.12
September	74.9	2.74	75.8	2.88	73.3	2.81	75.2	3.72
October	64.3	2.01	65.7	2.44	61.1	2.03	63.4	1.10
November	55.2	3.75	55.7	3.13	50.6	3.13	54.1	2.56
December	48.5	4.88	49.1	4.50	42.8	4.80	46.1	4.98
Year	64.0	49.20	65.1	51.16	61.4	47.49	63.6	48.24

Dates of first and last killing frosts.

Year.	Greensboro, Ala.		Montgomery, Ala.		Aberdeen, Miss.		Macon, Miss.	
	Last in spring.	First in fall.	Last in spring.	First in fall.	Last in spring.	First in fall.	Last in spring.	First in fall.
1902	Mar. 19	Nov. 27	Mar. 19	Nov. 28	.....	Nov. 28	.....	.....
1903	Feb. 23	Oct. 24	Feb. 19	Nov. 18	Mar. 26	Oct. 25	Mar. 2	Oct. 25
1904	Mar. 1	Nov. 14	Mar. 4	Nov. 14	Apr. 5	Oct. 23	Apr. 13	.....
1905	Feb. 22	Nov. 30	Feb. 18	Nov. 30	Apr. 17	Nov. 11	Apr. 17	Nov. 30
1906	Mar. 21	Oct. 29	Mar. 21	Nov. 13	Mar. 21	Oct. 11	Mar. 21	Oct. 11
1907	Feb. 15	Nov. 12	Feb. 16	...do....	Apr. 14	Oct. 29	Apr. 14	Nov. 13
1908	Feb. 27	Nov. 6	Feb. 28	Nov. 15	Apr. 4	Oct. 25	Mar. 21	Oct. 25
1909	Mar. 14	Nov. 19	Feb. 17	Nov. 19	Mar. 16	Oct. 13	Mar. 16	Nov. 19
Average	Mar. 4	Nov. 12	Feb. 28	...do	Apr. 1	Oct. 28	Mar. 28	Nov. 5

PREPARING THE LAND FOR SEEDING.

Generally speaking the seeding of a field to alfalfa entails a considerable outlay of money and labor, and, as this crop is usually expected to occupy the land for a period of several years, it is good economy to spare no pains in the preparation of the soil for seeding. As a rule, however, a large percentage of the alfalfa sown in this prairie belt is put in on ground that has had little or no special preparation. Where alfalfa is to follow a cultivated crop like corn or cotton it is the common practice merely to break the land a few inches deep, harrow down smooth, sow the seed, and cover with a smoothing harrow. Where the land has been cultivated late in the season and is practically free from weeds, as is often the case with cotton, an excellent stand is quite frequently secured by merely running over the land with a stalk cutter, disking once each way, smoothing with a spike-tooth harrow, and sowing the seed. This is a very simple and cheap method of planting, but should never be followed except on fertile land that is free from weeds.

Where the land is reasonably fertile and has been in cultivated crops, it may be put in fine condition for sowing to alfalfa without any very expensive preparation. Such land should be broken in the fall to a depth of from 5 to 7 inches. Land broken in the fall or early winter will crumble and be reduced to a fine physical condition by the action of the winter rains and freezes. In February or early March this should be run over with a disk harrow and then worked down with a spike-tooth harrow until in fine tilth.

Land that is poor, thin, and unproductive should not be sown to alfalfa without first being put through a course of treatment to increase its fertility and improve its mechanical condition. A great many failures with alfalfa may be traced to the fact that it was sown on land too poor to produce other crops. Alfalfa is not a poor-land crop and, although it may bring better returns than any other crop on some of the thin soils of this belt, for best results it should be sown on a strong, productive soil, such as the Houston clay normally is.

Soils deficient in humus are usually in poor physical condition and are quite apt to "bake" or crust over after a hard, packing rain. Where such baking takes place soon after the seed is sown it greatly lessens the chance of securing a stand, as the young plants will be unable to break through the crust. Soils of this nature are greatly benefited by applying stable manure, or by growing some leguminous crop to be turned under.

On poor land, therefore, the preparation for alfalfa might well begin with the two preceding crops. The first of these should be a leguminous crop such as cowpeas, soy beans, or melilotus. These crops will not only add a considerable amount of organic matter to the soil, and thus improve its mechanical condition, but will also store up quantities of nitrogen in a form readily available for the young alfalfa plants. The melilotus, if it makes a satisfactory growth, will inoculate the land, as its roots are supplied with the same bacteria as required for the successful growth of alfalfa. On very thin land melilotus will probably do better than any of the other crops mentioned. It should be left two years for best results and may be pastured during this time or cut for hay the first year and pastured the second.

Bur clover is also an excellent soil enricher and is sometimes recommended as a preparatory crop for alfalfa, as it also will inoculate the land for the latter. There is considerable objection to its use in this connection, however, as it reseeds itself readily and is apt to come up in the alfalfa. Being a winter legume, it makes its heaviest growth in late winter and early spring, just when the alfalfa should have a clear field and it is apt to injure the stand of the latter.

The crop immediately preceding alfalfa should preferably be one receiving clean cultivation, though this is not always necessary. Young alfalfa plants are easily crowded out by weeds; hence the need of keeping the preceding crop as free from them as possible. For this purpose, where the alfalfa is to be sown in the spring, cotton is probably without a superior as a preparatory crop, owing to the fact that it is generally cultivated better and much later in the season than most other crops. Where the land is reasonably free from weeds, or it is not desirable to use cotton preceding alfalfa, a crop of cowpeas or soy beans sown in rows and given a few cultivations, and either grazed off or cut for hay or seed will answer the purpose very well. On lands strong in lime the soy bean is proving more satisfactory as a fertilizing crop than the cowpea.

In preparing the land it should be broken deeply for the preceding crop and only 3 or 4 inches for the alfalfa. Alfalfa requires a firm seed bed, and if the land is broken deeply just a short time before sowing, the soil will not have time to settle sufficiently for best results. In fact, if it were well broken for the preceding crop, it is sometimes

best not to break the land at all for alfalfa. One of the largest growers in Mississippi sows alfalfa on cotton land by simply breaking out the old cotton rows with a "middle buster," running a disk harrow at right angles to the rows, which leaves the land smooth, then running over the land once with a smoothing harrow. He then sows the seed in March or April with a wheelbarrow or end-gate seeder and covers with the smoothing harrow. He states that he gets better results from this method than from thoroughly breaking the land before seeding, and the operation costs less than half as much. Where alfalfa is to be sown after cowpeas, or a similar crop, the land may be simply disked each way and then harrowed down smooth if these preceding crops have been kept reasonably free from weeds.

If alfalfa is to be sown on land that is inclined to be open and loose, the soil should be firmed with a roller or plank drag before seeding. Where the soil is in a loose condition it will dry out much more rapidly than otherwise and the young plants are apt to suffer and die if a dry period occurs after they are up.

There are some areas of the Houston clay or the closely associated alluvial type, Trinity clay, which possess all the requirements of

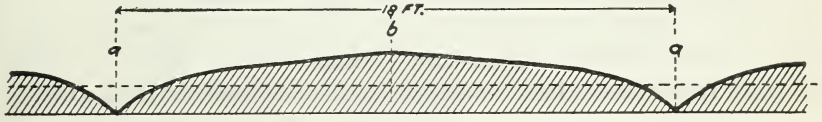

FIG. 4.—Showing method of plowing Houston clay to promote surface drainage. *a*, Open water-furrows having outlet into open ditch or stream; *b*, back-furrow, 15 to 20 inches higher than the bottom of the water-furrows. Dotted line shows original ground level.

good alfalfa land, except that they may be subject to an occasional overflow from excessive rainfall, or lie too flat for good surface drainage. Tile drainage would greatly benefit such soils, but where it is not convenient to resort to this method, plowing the land into beds from 15 to 20 feet wide will frequently give sufficient drainage to permit the growing of alfalfa.

In preparing land of this nature it should be thrown into beds separated by a deep water furrow opening into a ditch or stream, so that all surplus water will be quickly carried away. It will frequently be necessary to "back furrow" the land several times in order to get the middle of the beds raised to the required height. Figure 4 shows a cross-section of such a bed with the open water-furrow on each side.

LIMING.

While the black and gray Houston soils are generally richly impregnated with lime, there are to be found occasional areas which seem to be deficient in this necessary ingredient. Where this unfavorable condition prevails over a large area, it is doubtful if it will be good

economy to go to the expense of applying lime for the purpose of growing alfalfa unless the farmer has no other land suitable for the crop. But where these spots occur only in small areas in a field of good alfalfa land liming will pay.

A ton or so of burned lime to the acre will probably be sufficient to correct this deficiency. Better still is the ground unburned limestone, as it does not liberate as rapidly the nitrogen in the soil, as does the burned or caustic lime. Where ground limestone is used, about double the quantity should be applied, for, although more lasting in its effect than the burned lime, it is slower in its action upon the soil. Where the "rotten limestone" of this belt can be dug up and applied, it will answer the purpose.

INOCULATION.

Over most of the "black prairie belt" the soil appears to be naturally supplied with the bacteria which forms the tubercles on the roots of the plants, and inoculation is seldom necessary. This is particularly true of land on which melilotus has been grown, but even on such fields it will in some instances be a material advantage to inoculate unless the melilotus thoroughly covered the land. In fact, where it can be done cheaply it is advisable to inoculate unless quite certain that the soil already contains the necessary bacteria, and good results have been obtained from inoculation on soil already known to contain them.

Probably the surest and most satisfactory method of securing this necessary inoculation is by means of soil transferred from a field where alfalfa is being successfully grown. The greatest difficulty to be encountered in using this soil is the cost of labor necessary to secure and handle it and the cost of transportation if it has to be hauled or freighted for any considerable distance. Where soil can be obtained at only a short distance, the cost of handling will be slight.

The soil from a field of melilotus or bur clover will answer the same purpose as that from an alfalfa field and in many cases will be much easier to secure. If the alfalfa is to be sown on land that has recently grown either of these crops, no inoculation will be necessary, as the soil is reasonably sure to contain the bacteria. Care should always be taken to obtain soil from fields free from plant diseases and objectionable weeds.

Where plenty of suitable soil is to be obtained at a small cost for labor and hauling, it will be advisable to apply from 300 to 600 pounds to the acre. If it has to be shipped or hauled some distance or a large area of alfalfa is to be sown, it may not be good economy to apply more than 200 or 300 pounds to the acre, as these amounts, if carefully applied, will usually be sufficient to secure the desired

inoculation. Where only a small amount of inoculated soil is available, it should be mixed with several times its weight of ordinary soil to facilitate its even distribution.

One of the best methods of applying the soil is by means of a grain drill having a fertilizer attachment. In this way the soil is evenly distributed and is covered up and there is less danger of the bacteria being injured by being exposed to sunshine. Where a drill is not available, the soil may be sown broadcast by hand or with a lime spreader and harrowed in. The proper time to apply the soil is at the time of, or just prior to, sowing the seed. It should be applied on a cloudy day or late in the evening and immediately harrowed in with a smoothing harrow.

Where it is impossible to get soil for inoculating, a good application of well rotted stable manure will frequently answer the purpose. Even where soil is used it will be a distinct advantage to use stable manure, for the reason that it renders the soil more favorable for the development of the bacteria.

Alfalfa may also be inoculated by the use of pure cultures prepared by the Department of Agriculture. The advantages of the artificial cultures lie in the greater ease of their transportation and application, as well as in the absence of the danger of introducing harmful weeds or plant diseases, although this method of inoculating leguminous crops, especially in the case of alfalfa, is less certain than the soil-transfer method previously described.

SEEDING.

There is quite a wide difference of opinion among the successful alfalfa growers as to the best time to sow the seed. Some say that the seeding should always be done in the spring, while others contend that early fall is the proper time. The best time to sow will depend largely on the nature of the soil, its physical condition, the preceding crop, and moisture conditions.

On soils where crab grass and other weeds are apt to be troublesome it is generally advisable to sow in the fall, provided there is sufficient moisture in the soil to start the young plants off and enable them to make a good growth before cold weather. Fall-sown alfalfa will start off early in the spring and make a good growth before weeds can get started, consequently the latter will be smothered out. Another thing in favor of fall seeding, when it is practicable, is the fact that the yield the following year will be about double what it would be if the seeding be put off until spring.

Unfortunately, however, the fall months are usually too dry throughout this belt to admit of proper preparation of the land in time for fall seeding with any degree of safety. Where the prepara-

tion can begin early in July or August after early oats, corn, cowpeas, soy beans, or some similar crop has been removed, it is quite possible to get the land in suitable condition for fall seeding. Where alfalfa is to follow a general crop of corn or cotton, it is almost impossible to get it sown early enough in the fall for good results. Where the seeding can not be accomplished by the middle of October, it is usually safer to postpone it until spring.

It frequently happens that a prolonged drought makes it impossible to prepare the land for fall sowing, and even though the preparation could be made there will not be sufficient moisture in the soil to germinate the seed and allow the young plants to make a growth sufficient to enable them to withstand freezing weather. Probably the best and surest preparation for fall seeding would be to summer fallow the land—that is, break in the spring or early summer and repeatedly disk and harrow until seeding time. This practice tends to conserve moisture and will enable the plants to make sufficient growth before freezing weather safely to withstand an unfavorable winter. The objection to this method is the fact that it keeps the land idle during one growing season, but in many instances it will pay.

Where fall sowing is to be practiced, the seed should be sown between the last of August and the first of October. Occasionally a sowing as late as the last of November will be successful, but only when followed by an exceptionally mild winter. It is seldom safe to seed later than the middle of October.

Spring seeding is most commonly practiced in this prairie belt and there are many things in favor of this method. In the first place there is usually little trouble to be encountered in getting the land properly prepared, as the farmer will have ample time from November to the middle of February for breaking and harrowing his land. The distribution of rainfall is such as to favor spring sowing and there is no danger of the young plants being injured by freezing, as is apt to be the case with fall-sown seed. Where spring seeding is practiced the land is not idle during any part of the growing season.

Spring seeding may begin the last of February and continue until the middle of April, and frequently good results are obtained from sowing as late as the 1st of May. The best time is usually from the 1st to the 20th of March.

AMOUNT OF SEED TO SOW.

In many sections of the country from 10 to 20 pounds of seed should be sufficient to secure a good stand, but a study of the practices of the most successful alfalfa growers in this prairie belt shows that best results are obtained from sowing from 25 to 30 pounds to the

FIG. 1.—PATCHES OF BERMUDA GRASS TAKING HOLD OF HOUSTON CLAY.

As with Johnson grass, such areas are frequently skipped over in cultivating and allowed to spread over entire fields. Both of these grasses can be eradicated by tillage or by tillage and grazing.

FIG. 2.—ALFALFA RENOVATOR.

A useful implement for removing crab grass or for cultivating an alfalfa meadow.

ALFALFA AND ALFALFA HAY BARN ON HOUSTON CLAY, CLAY COUNTY, MISS.

acre. These larger amounts of seed are required owing to the fact that there are so many weeds which will come up and crowd out the young alfalfa plants unless the latter are thick enough to cover the ground from the start. Then, too, with the heavier seeding, the young plants are much surer of breaking through the crust should the surface of the soil tend to bake. Where the seeding is done with an alfalfa drill, thus insuring the covering of all the seed, a much smaller quantity will suffice.

METHODS OF SEEDING.

The seed may be broadcasted by hand or sown with a drill, wheelbarrow seeder, or hand seeder. When possible it is always a good plan if the seed are broadcasted to sow both ways on the field, as this lessens the danger of leaving any bare places or having the stand otherwise spotted and irregular.

The seed should be covered lightly with a weeder, smoothing harrow, or plank drag. The latter should not be used, however, if the ground is at all inclined to be rough, for under such conditions part of the seed would be covered much too deeply.

RESEEDING.

It not infrequently happens that the stand in a portion of an alfalfa field is wholly or partially killed out, making reseeding necessary. In such cases it is best to plow the land up and thoroughly prepare it again before reseeding. It is seldom, if ever, that satisfactory results will be obtained in this belt in trying to thicken a stand of alfalfa by disking and harrowing in the seed on an old alfalfa sod. The new plants will start off all right, but the old plants will make such a rapid growth that they will soon smother out all the young plants near them.

COST OF SEEDING.

The cost of seeding an acre of alfalfa on the Houston clay soils varies largely with the amount of preparation necessary to get the land in condition for sowing. Owing to the fact that it is necessary to use a larger amount of seed than is customary in less humid regions, the cost per acre for seed alone usually runs from $5 to $6. The expense of preparing the land will bring the total average cost up to $7 to $10 an acre. Where an extra amount of preparation is necessary, as is often the case with fall sowing, the total cost will frequently run much higher than the above figures, but the general average is close to $10 an acre.

ALFALFA ON JOHNSON-GRASS LAND.

A large amount of the land that is desirable for alfalfa in this prairie belt is now well set in Johnson grass, and the question is often raised as to whether or not it is desirable to try to kill the Johnson grass

before sowing the alfalfa. Many of the more extensive growers contend that the Johnson grass is really an advantage in their alfalfa, as it greatly increases the tonnage of hay secured during the season. As a rule, when a good stand of alfalfa is secured on Johnson grass, all the first year's crop will be mixed with Johnson grass. After the first year the first two or three cuttings secured each season will sell for straight alfalfa. The later cuttings will be mixed, and this mixed hay is getting to be regarded as a very desirable feed. In fact, many regard the mixed hay as superior to straight alfalfa for feeding to driving horses and work animals, as it is more nearly a balanced ration and not as laxative in its effect.

Where Johnson-grass land is to be sown to alfalfa, it is generally best to break the land in the fall or early winter, so that the soil may get the benefit of the winter rains and freezes. While this early breaking is desirable it is not always absolutely necessary, many instances being noted where perfect stands were secured by breaking the land only a week or 10 days before seeding. Such practice is not to be recommended, however, as the land is apt to break up into clods and as unfavorable weather conditions will frequently make it impossible to get the soil in the necessary state of preparation where the breaking is delayed until so near the time for seeding.

ALFALFA ON BERMUDA SOD.

In many sections of this prairie belt there are to be found considerable areas of excellent alfalfa land that have been completely taken by Bermuda grass. As a rule, where this condition prevails, the Bermuda is either cut for hay or utilized for pasture and, owing to the difficulties attending its eradication, but little or no attempt is made to grow cultivated crops on land infested with this grass. Some farmers have found, however, that their Bermuda meadows and pastures may be greatly benefited by seeding them to alfalfa. The alfalfa will not do as well as if no Bermuda were present, but, if the soil is good alfalfa land, it will generally pay for the expense of putting it in. Not all land in this belt which produces good Bermuda will grow alfalfa, so the farmer should be sure on this point before going to the expense of sowing alfalfa on such land.

Where alfalfa is to be sown on Bermuda sod it is usually best to break the land in the fall or early winter, disk it several times, and sow the seed in March or April. Fall sowing would probably give as good results but for the fact that it will be very difficult to get the ground properly prepared. The Bermuda makes a very tough sod, which can be broken only when the ground contains considerable moisture, a condition which seldom occurs early in the fall. Some claim to have succeeded in getting a stand by simply sowing the alfalfa seed on the unbroken sod, but this can hardly be considered a a safe practice.

On the more fertile soils, alfalfa mixed with Bermuda will yield from three to five cuttings during the season, if utilized as a hay crop and not grazed. In pastures it will lengthen the grazing period by several months and, in years when mild winters occur, this combination of Bermuda and alfalfa will furnish an almost continuous pasture throughout the entire year.

CUTTING AND CURING.

The first crop of alfalfa is usually ready for the mower by the first of April, and the last in November or December. This makes the haying season extend over a period of some eight months during which time from four to six crops are harvested.

TIME TO CUT.

It was formerly, and is still, the common practice in many sections to use the blooming period of alfalfa as a guide to the proper time for cutting the crop. With some growers it is the practice to cut just as the plants are beginning to come into bloom, while others wait until about one-third or one-half of the plants in the field are in blossom. (Pl. II, fig. 2.) A safer method is to cut when the buds which are to form the new shoots at the base of the plants are just starting. This will sometimes occur before many blossoms have made their appearance, and again not until the majority are in full bloom. If alfalfa is cut before these buds are ready to start the new growth is apt to be delayed, while if the cutting is made after the new growth has attained some height, part of the new shoots will be cut off and the succeeding crop injured.

CURING.

There are always times in a humid climate when it is more or less difficult to cure alfalfa in a satisfactory manner. The market demands a "pea green" hay, and this desirable color is often difficult to secure in this prairie belt on account of the heavy precipitation in the spring and early summer. The first cutting usually comes early in April and the later ones at intervals of 30 to 40 days. (Pl. III and VII.) As rainy days are apt to occur with more or less frequency throughout April, May, and June, and as alfalfa that is partly cured is very easily damaged by rain or heavy dews, a great deal of care is necessary in saving these first cuttings in good condition, and the alfalfa grower should have ample equipment of tools and labor so he can take advantage of every favorable day during this portion of the year.

There is a wide difference in the methods of curing practiced by different alfalfa growers. Some contend that curing in the windrow is the only way, while others secure best results from curing in the

cock. The success of any one method, however, depends largely on the man in charge of the work, his ability to take advantage of weather conditions, and the equipment of teams, tools, and labor at his disposal.

Curing in the cock is gaining in favor and promises to become the most common method of handling the crop. Alfalfa handled in this manner cures out more evenly, holds its leaves better, and retains a more uniform color than when cured in the swath or windrow. Alfalfa can be put in the cock before the leaves are dry enough to shatter and in a few days will cure out so that it can be baled or put in the stack or mow with little danger of spoiling.

The following extract from a letter written by Mr. C. T. Douglass, one of the most successful alfalfa growers in this entire belt, discusses his method of curing alfalfa in the cock:

We begin cutting alfalfa in the spring as soon as we find about one-half of the plants in bloom. We start the mowers as early in the morning as we can get to the field, regardless of dew, cloudy weather, or perhaps rain. In fact, we start the mowers even when a drizzling rain is falling and there is every indication of its continuing to rain. In that case the alfalfa lies on the ground until the sun comes out and cures it sufficiently so it can be raked into windrows. It frequently happens that early in the season, when the first crops are ready to cut, we have only a few days without rain; and unless we have the alfalfa cut and ready for the sun when it comes out, we would not be able to care for very much. Rain on the freshly cut, green alfalfa does not injure it materially; it is the rain that comes after it is partly cured that does the damage. For instance, on one occasion we had newly cut alfalfa lie in the swath for 10 days (the next crop having grown up through it) and then cure out and make hay that sold for $12.50 a ton.

As soon as the alfalfa is cured into a limp state it is raked into windrows and immediately pushed with a lift rake into piles of about 300 or 400 pounds each. These piles are then rounded into cocks and left to cure from 2 to 6 days, depending upon the weather. As soon as the hay in these cocks goes through a sweat, which is usually about the third day, the cocks from 8 to 10 acres are pushed with the lift rake to one place in the field, care being taken to place them from 8 to 10 feet apart, so that they can be opened and exposed to the sunshine.

Hay cured in this manner is usually ready for the press after being exposed to the sun for 2 or 3 hours, or when a handful of hay can be broken up by giving it three or four twists in the hands. In baling we have the tension of our press adjusted to the desired weight of bale, so that in tying there will be about 4 inches of space between the wire and the hay. As the bale is pushed out of the press it expands and the wire will tighten.

If more cured hay is ready for the press than can be baled before night it is ricked and covered with a 12-ounce 20 by 30 foot canvas stack cover to protect it from the rain and dew. Such covers are also very useful for covering the baled hay in case of sudden showers, and will pay for themselves several times over in a season.

The baled hay should be set on end or stacked on edge (leaving a space between the bales for the circulation of air) and cross-stacked. After a few days the bales can be restacked as desired.

We find that the great secret in getting our hay saved in proper condition is not to rake too green, and practical experience alone will enable the farmer to determine when the hay is in proper condition to rake. It is just about as detrimental, however, to let the hay cure too much or get too dry, as these conditions always result in the loss of a large per cent of the leaves by shattering.

Some growers are using canvas or muslin hay caps in connection with curing their hay in the cock. These are a decided advantage in protecting the cocked hay from sudden showers, and also from the bleaching of the outside of the cock caused by the alternate dampening by the heavy dews and drying out by the sun. When these covers are used on cocks of partly cured hay the covers should be removed a few hours on bright days or moisture will collect underneath them and retard rather than hasten the process of curing.

When the hay is cured in the windrow it is the common practice to cut as soon as the dew is off, and when the hay is thoroughly wilted rake into a large windrow. If rain or an exceptionally heavy dew falls on the hay while still in the windrow it should be gone over with the tedder to shake off the excess of moisture before the sun has had a chance to dry it out. If the hot sunshine strikes the partly cured alfalfa when covered with dew or rain, it will bleach and seriously injure the quality of the hay.

One great drawback to this method is the danger of damage by rain, as the partially cured hay will spoil much quicker by getting wet in the windrow than it will if in the swath or cock. Then, too, it is seldom possible to get the hay cured as evenly as when put in cocks, owing to the fact that a large percentage of the leaves become so dry and brittle that they can no longer continue to draw moisture from the stems, thus insuring an even cure.

Alfalfa properly cured in the windrow should be stacked or put in a shed. Some farmers are successful in baling from the windrow; but this is not usually a safe practice, as the hay is apt to heat and mold in the middle of the bale. Alfalfa stacks should always be protected with canvas covers or covered with green hay, to a depth of 18 inches or 2 feet. This green hay when settled will make a covering that will shed water much better than the cured hay.

Sheds are desirable and much safer than putting the hay in stacks. A shed 40 feet long by 20 wide with 15-foot posts will hold, approximately, 30 tons of hay and will pay for itself in a short time.

A few growers have tried curing their alfalfa in sheds, with very satisfactory results. The alfalfa is cut when the dew is off, and as soon as it is thoroughly wilted, hauled to the shed and spread out as thinly as possible. It should never be over 3 feet deep when spread out or it will be apt to heat and mold. Hay cured in sheds in this manner comes out bright green, retains its leaves well, and is of a better quality and will sell for a higher price than that cured in the field. The plan is hardly practicable, however, except for the farmer who has only a small area of alfalfa, or one who has plenty of shed room available. Where a large quantity of alfalfa is to be cured, it is doubtful if the expense of building sheds for this purpose alone would be justified.

Sheds or storage rooms of some sort are absolutely essential for sheltering the baled hay unless it is to be shipped direct from the baler.

PASTURING ALFALFA.

Alfalfa makes good pasture for nearly all kinds of farm animals. Hogs and horses may be pastured on alfalfa, at any stage of its growth, without any danger of being injured. Cattle and sheep may also be safely grazed on alfalfa when it is mature, but with these animals there is always more or less danger from bloating when they have access to the young, succulent growth. It is not generally advisable, however, to run stock on a field that is to be cut for hay. This is especially true of the early spring growth. On the thinner areas of land it sometimes happens that during a severe drought in August and September, the alfalfa will not get large enough to cut to good advantage. When this occurs the alfalfa may be grazed by any kind of stock with good results. A limited number of hogs running on alfalfa meadow will not materially damage it if they have rings in their noses to prevent rooting and are not allowed to run on the field during wet weather.

Alfalfa is probably without an equal as a grazing crop for hogs, and its utilization in this manner is getting to be very popular in the Alabama-Mississippi prairie belt. One acre of good land well set in alfalfa will furnish grazing for 10 to 15 head of hogs from the middle of March or first of April until October, and sometimes every month in the year.

A 7-acre field of alfalfa in Perry County, Ala., furnished grazing for 115 to 123 head of hogs from March 28 to October 1, and also produced nearly 1 ton of hay to the acre.[1] Hogs grazing on alfalfa should receive from 1 to 2 pounds of corn or other grain to the 100 pounds of live weight. On a ration of this kind they will keep in excellent growing condition and require but a comparatively small amount of grain for finishing off. They should also have access to a Bermuda pasture and be kept off the alfalfa when the ground is wet enough to become muddy from their tramping.

When pasturing alfalfa it is not advisable to run enough stock on the field to keep the plants grazed close. The practice which seems to be most satisfactory is to have the pasture of sufficient area to furnish grazing for the desired number of animals and in addition furnish at least two crops of hay. Where this system is in vogue it is the practice to mow one half of the field as soon as the alfalfa is ready. In a few days the young shoots on this portion of the field will be large enough to graze and the animals will leave the old alfalfa on the other half of the field for this tenderer growth. In a week or two the

[1] Farmers' Bulletin No. 310.

remainder of the field is mowed. This practice gives the animals tender and succulent grazing at all times, and also gives each half of the field alternating periods of rest.

ENEMIES OF ALFALFA.

Crab-grass is probably the greatest weed enemy of alfalfa on the Houston clay soils. It is seemingly less persistent on those soils having a high percentage of lime. To keep crab-grass from injuring a stand of alfalfa it is advisable thoroughly to harrow the field immediately after each cutting. For this work a spike-toothed harrow with the teeth set straight, or disk harrow, with disks set nearly straight, may be used. There are also special tools, known as alfalfa renovators, manufactured for this purpose. These are in the nature of a disk harrow, except that the disks, instead of being solid, are made up of spiked teeth, which in revolving dig up the ground and tend to lift out the crab-grass plants. (Pl. VI, fig. 2.) It may be necessary to weight down the spiked-toothed harrow and go over the meadow several times to secure the desired results. Where the work is done with the disk harrow or alfalfa renovator, it will be advisable to follow with the spike-toothed harrow which will drag out the crab-grass roots.

Dodder, or, as it is commonly called, "love vine," is another bad alfalfa weed. There are several kinds of dodder to be found in this section, but only two or three of them are really detrimental to the alfalfa. Some of the native dodders may be seen growing in profusion along hedge rows and ditch banks. These also appear in the alfalfa fields but are not usually much in evidence after the first cutting. The alfalfa dodders, however, if not killed out early in the spring are apt to be scattered over the field by the rake and so thoroughly infest the meadow that it will be necessary to plow it up.

Dodder is usually introduced with the alfalfa seed and will first be noticed as a slender, yellowish, threadlike growth on the young alfalfa stems and leaves. If left unmolested it will soon be a tangled mass and spread very rapidly over a considerable area. It is advisable, therefore, to keep a careful watch over the young meadows and take steps to eradicate the pest as soon as it makes its appearance.

If the dodder occurs only in occasional spots in the field it may be destroyed by cutting all the infested plants close to the ground and removing them from the field. If it is well distributed over the entire meadow, about the only way to get rid of it is to plow up the field and plant to cultivated crops. In some sections pasturing is said to be effective in destroying this pest, but this method would hardly be practicable in this belt except on comparatively small areas.

ALFALFA IN ROTATION.

Alfalfa is well adapted to be grown in rotation with other crops in this prairie belt, and can be used to good advantage in this way where it is desirable rapidly to increase the fertility of the land. Owing to the longer growing season in the South, it develops much more rapidly here than it does in the North and West, and can be worked into a comparatively short rotation, but, as long as the present price of hay prevails it will hardly be advisable to plow up a field of alfalfa unless the stand has become impaired. A good stand may produce profitable crops for a long period of years, yet it not infrequently happens that grass and weeds will seriously injure a stand of alfalfa after from four to six years. When this condition occurs it is always advisable to plow it up and plant the land to cultivated crops for two or three years before seeding to alfalfa again.

Corn is usually the best crop with which to follow alfalfa and a great increase in the yield of grain generally results.[1] In 1906 a field of alfalfa in Alabama which had been pastured by hogs two years was plowed up and planted to corn. Before this land was sown to alfalfa 18 bushels of corn to the acre was considered a maximum yield under ordinary conditions. The corn on the alfalfa land yielded 45 bushels of shelled corn to the acre, while on land adjoining which had been heavily manured in addition to having a crop of cowpeas plowed under, the yield was only 32.9 bushels. In 1907 an adjoining field of alfalfa which had been mowed two years and pastured one year made a yield of over 54 bushels to the acre when plowed up and planted to corn. The man on whose farm these results were obtained says that he considers alfalfa the cheapest fertilizer he can use.

The yields of cotton are materially increased where that crop is planted after alfalfa. On the more fertile soils, however, there is often a tendency to make stalk or "weed" at the expense of fruit. For this reason it is not generally advisable to plant cotton after alfalfa unless it is the aim to get the land reseeded to the latter crop as soon as possible.

One of the most satisfactory rotations is: Alfalfa from four to six years, or as long as it is producing profitable crops; corn, one year; cotton, one year; then back into alfalfa. If it is undesirable to use cotton, soy beans may be substituted, or the land may be planted to corn two years.

In breaking up a field of alfalfa it is always desirable to break in the fall and then rebreak in the winter. This practice will tend to destroy many cutworms and other insects which would injure the following crop.

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[1] See Farmers' Bulletin No. 310.